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PROFIT-MAXIMIZING PRINCIPLES, INSTRUCTIONAL UNITS FOR VOCATIONAL AGRICULTURE.

BY- BARKER, RICHARD L.
OHIO STATE UNIV., COLUMBUS, RESEARCH FOUNDATION

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DESCRIPTORS- *TEACHING GUIDES, *VOCATIONAL AGRICULTURE, *FARM MANAGEMENT, HIGH SCHOOLS, BIBLIOGRAPHIES,

THE PURPOSE OF THIS GUIDE IS TO ASSIST VOCATIONAL AGRICULTURE TEACHERS IN STIMULATING JUNIOR AND SENIOR HIGH SCHOOL STUDENT THINKING, UNDERSTANDING, AND DECISION MAKING AS ASSOCIATED WITH PROFIT-MAXIMIZING PRINCIPLES OF FARM OPERATION FOR USE IN FARM MANAGEMENT. IT WAS DEVELOPED UNDER A U.S. OFFICE OF EDUCATION GRANT BY TEACHER-EDUCATORS, A FARM MANAGEMENT SPECIALIST, AND TEACHERS AND REFINED AFTER TRIAL USE IN 16 HIGH SCHOOLS. UNITS INCLUDE DIMINISHING RETURNS, FIXED-VARIABLE COSTS, SUBSTITUTION, OPPORTUNITY COSTS, COMBINATION OF ENTERPRISES, AND TIME RELATIONSHIPS. EACH UNIT IS ORGANIZED TO TEACH ECONOMIC PRINCIPLES BY THE INDUCTIVE PROCESS. TERM DEFINITIONS, OBJECTIVES, AND STATEMENT OF PRINCIPLE ARE GIVEN FOR THE WHOLE UNIT. EDUCATIONAL EXPERIENCES (EXAMPLES INCLUDING LEADING QUESTIONS, KEY QUESTIONS, AND CONCLUSIONS), ASSOCIATION OF EXAMPLES, FORMULATION OF THE PRINCIPLE, AND STUDENT ACTIVITIES (APPLICATION OF THE PRINCIPLE) DEVELOP THE CONTENT. TABLES, ILLUSTRATIONS, SUGGESTED TEACHER ACTIVITIES, STUDENT EXERCISES, QUIZZES, AND REFERENCES ARE GIVEN. SEVEN WEEKS ARE REQUIRED FOR COMPLETION OF THE SIX UNITS. THE GUIDE IS IN LOOSELEAF FORM IN A PLASTIC BINDER. THIS DOCUMENT IS ALSO AVAILABLE FOR $2.00 FROM OHIO VOCATIONAL AGRICULTURE, INSTRUCTIONAL MATERIALS SERVICE, THE OHIO STATE UNIVERSITY, 2120 FYFFE ROAD, COLUMBUS, OHIO 43210. (JM)

PROFIT-MAXIMIZING PRINCIPLES

Instructional Units for Vocational Agriculture

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State Department of Education
Columbus, Ohio

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The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Materials Service

(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio 43210

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FOREWORD

This teacher's manual is the result of a cooperative effort of the Department of Agricultural Education; The Ohio State University, the Agricultural Education Service; Ohio State Department of Education and The U.S. Office of Education.

The contents of this publication include instructional units designed to assist teachers of vocational agriculture in enhancing student understanding of basic economic principles as applied to farm business management. Basic principles were concentrated upon, since they lend themselves to student knowledge and application of the "whys" in agricultural business decision making. Uniqueness exists in the instructional units in that they were designed to be taught by the inductive process of teaching with the discovery approach to learning.

Preliminary instructional-unit construction was done under the direction of Ralph E. Bender, Chairman; Floyd G. McCormick, and Richard L. Barker, Department of Agricultural Education, The Ohio State University. The following teachers of vocational agriculture were instrumental in basic unit development:

Richard Adams	Carl Nagy
Homer Burt	Harry Plank
Homer Brown	Ben White

The instructional units were critically reviewed by Dr. Richard H. Baker, Farm Management Specialist, Department of Agricultural Economics, The Ohio State University.

Once developed, the instructional units were field tried and evaluated by sixteen teachers of vocational agriculture in Ohio. The units contained in this publication are a revision of the original material which was adjusted as a result of the field trial and the suggestions offered by teachers, supervisors, and teacher educators.

Ralph E. Bender
Project Administrator and Chairman,
Department of Agricultural Education,
The Ohio State University

TABLE OF CONTENTS

TO THE TEACHER

This teacher's manual is to assist the teacher in stimulating student THINKING, UNDERSTANDING, and DECISION MAKING as associated with Profit-Maximizing Principles.

These Units have two basic objectives:

1. To teach the understanding of selected economic principles applicable to farm business management.
2. To teach by the INDUCTIVE PROCESS which is a procedure of reasoning whereby students build a general principle from the interpretations of a number of similar situations.

Class Time: The principles approach takes longer to cover subject matter but does so with greater understanding and in-depth coverage. Approximately seven weeks is required to complete all six units.

Study the Introduction before using these units. The teacher should read carefully the introductory section which includes the PREFACE and INTRODUCTION. This section explains the use of the principles approach in the development of understanding and student application of economic principles.

Definition of Terms is extremely important. Teachers should not use terms that students are unfamiliar with. Terms that should be defined with the students and clearly understood by them are located on the cover page of each unit. You may find it helpful to place these on the chalk board during the entirety of unit instruction.

Leading Questions are part of the INDUCTIVE PROCESS. Many approaches need to be explored before arriving at the principle. It is part of the teacher's job to ask questions that will lead in the direction of the principle. Each unit offers suggested questions. You may want to delete some or to add others. Questions should be appropriate and timely. One basic purpose of these questions should be to create problems which students will want to solve.

Many Examples are presented to show that there are different applications of the same principle. They are to build upon one another until the principle is developed. You may wish to add to them using familiar examples and situations. Local and current adjusted prices and yields should be used when applicable.

Many Illustrations in this manual have been placed on separate pages allowing the teacher to remove and reproduce them for class use.

Student Work Sheets and Sample Unit Quizzes have been prepared and are placed at the conclusion of each unit. They are designed to show the application of the given principle. You will want to add to them.

Reference Materials that teachers should utilize are listed at the end of each unit. You should not rely entirely on the manual for your understanding of economic principles. The principles approach requires greater amounts of time for teacher preparation and review of technical subject matter.

PROFIT-MAXIMIZING PRINCIPLES

Diminishing Returns:

1. Physical. The application of additional units of variable resources to a unit of fixed resource increases total output but, after a certain point, the amount added to total output by each successive unit of variable resource diminishes.
2. Economic. After a certain point, the economic returns for each successive unit of variable resource added to a unit of fixed resource tends to decline. However, the farm manager, in order to secure maximum profits, should continue adding variable resources to fixed resources as long as marginal returns are greater than marginal costs.

Fixed-Variable Costs: The cost per unit of production can be decreased by spreading fixed costs over more units of production. Therefore, the farm manager should continue using more resources, if capital is available, to increase production as long as variable costs are covered by the marginal returns.

Substitution: When two or more types of resource inputs can be used to produce a given amount of output, the value of the resource replaced or displaced by another resource should be greater than the value of the resource added if the farm manager is to secure maximum profits.

Opportunity Costs: The profit of a farm business will be greatest if each unit of land, labor, and capital is used where it will add the greatest marginal returns to the farm business; thus, the farm manager cannot change the distribution of a single unit of variable resource input without reducing farm income.

Combination of Enterprises: The best combination of enterprises is where a farm business is so organized that the farm manager cannot add to or expand the size of one enterprise or delete or contract another enterprise without reducing income of the farm business.

Time Relationships (Time Comparison): Before investing limited capital resources in the farm business, the farm manager should determine the present value of future income in order to make comparisons between alternatives over time; that is, determine the economic feasibility of making capital investments in the present to obtain income in the future.

PREFACE

Teachers of vocational agriculture have too often focused their teaching primarily upon facts of production practices and procedures. Accelerated changes due to economic, scientific, and technological developments have forced agricultural educators to take a critical look at previous instructional programs in vocational agriculture in an attempt to make adjustments to better meet the educational needs of a more diversified clientele. To meet these needs, courses of study in vocational agriculture must provide greater "in depth" instruction and, at the same time, provide for transfer of learning and "carry-over" to all facets of agricultural occupational endeavors.

Principles Approach

No longer is it educationally sound to teach only the specific facts relating to production agriculture. We need to broaden our teaching approach by blending in the "why" with the "know how" aspects of agriculture. Today's facts soon become tomorrow's history. For this reason, instructional programs in vocational agriculture should place increased emphasis on teaching for greater understanding of basic principles that have continued application to the total world of work in agriculture.

The "principles approach" lends itself to instruction that is pointed toward the development of understanding and the ability to make appropriate application of this understanding. It must be remembered that the ultimate objective of any effective instructional program is not only the acquisition of knowledge or understanding but also the application of this knowledge to actual situations and/or problems. Instructional programs dealing with economic principles are no exception. In essence, understanding of economic principles must be carried to the application stage if sound decision-making is to result.

Inductive Teaching

Teaching is directing the learning process. Inductive teaching is helping students discover the "why" by developing understanding of a principle through the use of situations and problems that illustrate the principle, either in whole or in part. The inductive teaching approach leads students from simple, concrete situations to complex generalizations evolving from the association of commonalities of a number of examples and, finally, to the discovery of the principle itself. Inductive instruction starts with examples

familiar to the students that illustrate a principle and should eventually lead students to discover and develop a working definition and an understanding of the principle with the assistance of the teacher. The success of inductive teaching and the discovery method depends largely upon the questions asked of the students. Questions should be appropriate and timely. One basic purpose of the questions should be to create problems which students will want to solve. In the design of the instructional units contained in this manual, care has been taken in structuring questions to promote student interest and participation.

INTRODUCTION

As a move to meet the increasing challenge to teachers of vocational agriculture to provide more meaningful experiences to their students, instructional units have been developed around six Profit-Maximizing Principles. These principles provide an accepted guideline to sound decision-making that affects the profitability of the farm-firm business. These principles are as follows:

1. Diminishing returns
    a. Diminishing physical returns
    b. Diminishing economic returns
2. Fixed-variable costs
3. Substitution
4. Opportunity costs
5. Combination of enterprises
6. Time relationships

A principle connotes a fundamental truth, a law of conduct that has general applications. It is a generalization based on facts and on elements of likeness common to a number of situations. Once a thorough understanding of a principle has been acquired by an individual, it is possible for him to apply this knowledge to all facets of agricultural decision-making. Thus the individual is equipped with fundamental tools which should help him to answer the questions, "Why?", "Why does this occur?", "Why do we get these results?".

In the development of these units, effort has been made to adapt the technical information dealing with each principle: (1) to the level of high school students' comprehension, and (2) to strengthen instruction in decision-making by developing understanding of economic principles.

Each instructional unit consists of the following sections:

I Unit Title
II Unit Objectives
III Introduction
IV Teaching-Learning Activities (Educational Experiences)
V Association of Examples
VI Arriving at the Principle
VII Student Activities
VIII Source References

Unit Objectives

Unit objectives have been formulated in such a manner that they can be observed and measured. Thus, it is possible for the teacher to appraise the relative behavioral change brought about in the student as a result of instruction. Educational experiences have been selected which will contribute to the attainment of the specific unit objectives.

Introduction

Techniques for introducing each unit have been suggested which should have appeal to the student considering his background and experience. It should be pointed out that in introducing each unit, teaching and learning will also be taking place. It is not intended that introductory sections of the units be divorced from the suggested educational experiences. Instead, the introduction should flow directly into the teaching-learning activities suggested for each unit.

Teaching-Learning Activities

Educational experiences in the form of examples have been suggested to assist the teacher in developing a more complete understanding of each specific principle. The examples incorporated in each unit have been developed to help the teacher bring out certain ideas. Ideas to be emphasized with each example progress from the simple to the more complex. Each succeeding example builds upon the ideas stressed in the previous example and, at the same time, presents additional thoughts that will help develop greater understanding.

Each example is subdivided into five parts. First, there is a brief description of the example or situation. This is followed by a list of leading questions that should help to capture the student's interest by focusing in on the example. These lead questions are only suggestive and are presented as such to provoke ideas on how a teacher might introduce the chart or table used to illustrate the specific example. Associated with each table is a notation to the teacher identifying the suggested ideas to be emphasized with the example.

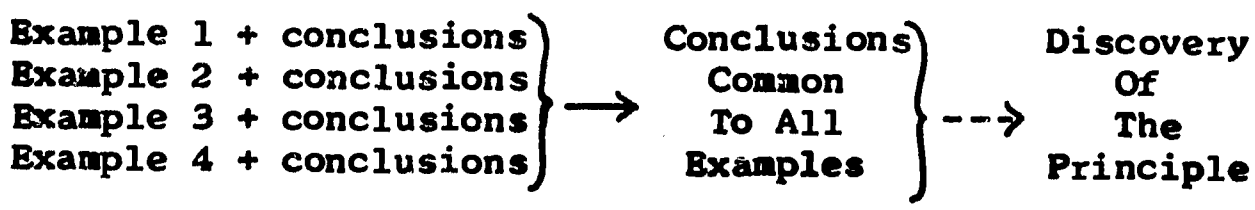
A list of key questions has been developed to assist students in reaching conclusions relative to the example under consideration. The intent of these questions is to help the teacher, through the use of the questioning technique, draw from the students the conclusions derived from the observation, study, and discussion of the example.

Finally, the pertinent conclusions to be drawn from the example are identified. These conclusions are stated in terms of the

example; not necessarily in terms of the specific principle. Terms pertaining to the principle have been identified and placed in parentheses. In drawing conclusions from the students, the teacher should attempt to identify the conclusions listed but, under no circumstances, should the teacher list them on the board per se. Instead, the teacher should list only those conclusions that are identified by the students. When students are unable to arrive at valid conclusions, the teacher should present additional examples that will bring out the ideas desired. This procedure is imperative if students are to be led to the eventual discovery of a principle. A list of student-derived conclusions for each example discussed should be kept in student notebooks for future use. After conclusions for the respective example have been identified by the students, the teacher should proceed to the next example. Student work sheets have been inserted within each unit which are only suggested activities to break the monotony of reviewing examples. By no means should the teacher use them in a manner whereby they interfere with student discovery of the commonalities existing among examples. Should this condition occur, the student will fail to recognize the underlying principle involved.

Association of Examples

After the students have observed, discussed, and formulated conclusions for each suggested example in the unit, they should begin to see the relationship existing between these examples. To help students discover the elements of likeness, the teacher should bring together the student-derived conclusions for the previous examples by briefly reviewing the examples and accompanying conclusions. In some instances, it may be necessary to have the students re-formulate the conclusions that they had identified at the time the example was discussed. A brief review of the student-derived conclusions for each example observed and discussed should help the students arrive at conclusions or generalizations common to all examples. This concept may be depicted as:



Arriving at the Principle

The next logical step after establishing common conclusions is to formulate generalizations that will help the student in arriving at a working definition of the specific principle. These generalizations should be listed on the board before stating the specific

principle. Care should be taken throughout the expanse of these instructional units not to teach for the purpose of learning principles per se. The memorization of definitions as listed in each unit is not the purpose of these materials. It is the "fundamental truths" or generalizations and concepts underlying each principle that are of greatest value to the students' growth and development.

Student Activities

Suggested student activities have been included which should help establish understanding of the principle in the minds of the students. Students should become involved in those activities that will help test their understanding and, in certain cases, provide for the actual application of their newly acquired understanding.

Student work sheets and sample quizzes have been appended to the student activities section. These items are not the panacea for evaluating student understanding of the given profit-maximizing principle. The teacher should supplement them to meet the needs of his students and the local situation.

Source References

A list of references pertinent to specific profit-maximizing principles is located at the end of each unit. The teacher will find it extremely helpful to examine these books in order to gain greater insight to the ramifications of the given economic principle. Books by Castle and by Heady and Jensen have been found to be especially useful for the teacher.

Further Suggestions

It is suggested that teachers follow the same general sequence in using the suggested examples to develop understanding of specific principles. This sequence should be used within each unit. Likewise, it is suggested that Unit I through IV be taught consecutively since each of these units builds upon the previous one. However, it should be kept in mind that the teacher can only use these materials as guides for his daily lesson planning. Only he knows his students and the environment in which they learn best. Therefore, the contents of these units are only recommendations. The teacher may wish to expand upon the material presented by adding local examples to strengthen his lesson plans.

In order for the teacher to realize the full impact of inductive teaching, there are several cautions that should be kept in mind.

1. Instruction should not start with a statement of the principle, but with situations that illustrate the principle. The pattern of progressing from simple to complex ideas should be followed.

2. Do not call for conclusions or generalizations before the students possess an adequate vocabulary and understanding of the given situation or example.

3. The teacher must understand the conclusions involved in a given example; otherwise, he will mislead and confuse the students.

4. Do not call for over-all generalizations before the students have noticed basic similarities existing among the examples presented. Otherwise, a contest may result whereby the students begin guessing to find out "what does the teacher want me to say."

The teacher should develop visual aids, either charts or transparencies, for each example used to develop basic understanding of the principles. These visual aids will become invaluable when the teacher begins to associate the examples and student-derived conclusions to help students to discover the elements of likeness existing between the examples suggested for each unit. Other educational experiences such as demonstrations and field trips are advocated whenever applicable.

DIMINISHING RETURNS

Part I - Physical
Part II - Economic

Suggested Teaching Time: 2 weeks

Terms Used In This Unit:

Cost of Production: Monetary outlay for the fixed and variable input factors needed to obtain output.

Diminishing: Decreasing.

Diminishing Physical Returns: Marginal outputs decreasing with each additional unit of input.

Factors of Production: Land, labor, capital, management.

Fixed Input: A factor whose quantity is given and not subject to variation by the producing unit during the time period in question.

Fixed Resource: A factor of production which does not vary with units of total production such as a single acre of land.

Gross Income: Total of all receipts from a project before expenses are deducted.

Input: A factor of production or basic resource; may be fixed or variable in nature.

Marginal: Added or additional.

Marginal Cost: The change in total cost, or total variable cost, due to one-unit change in output.

Maximum: The greatest value attained.

MC = MR: Marginal Costs equal Marginal Returns.

Minimum: The lowest point or value attained.

Net Returns: The financial returns after all costs have been paid.

Output: Unit of production resulting from the combination of variable and fixed inputs.

Production: The combining of inputs to yield output.

Production Costs: The value of the resources used to obtain output.

Profit: The excess of returns over expenditures.

Total Cost: The sum of the cost of variable inputs and the cost of the fixed inputs at any given level of production.

Total Revenue: Revenue obtained from the sale of output; found by multiplying the price per unit by the number of units sold.

I. TEACHING UNIT: PRINCIPLE OF DIMINISHING RETURNS

II. UNIT OBJECTIVES:

A. To discover that additional inputs must be applied to a fixed resource to increase total output.

B. To identify the point where the amount added to the total output by each additional unit of input diminishes or declines.

C. To associate the principle of diminishing returns to all input-output relationships.

D. To discover that the point of optimum combination of inputs can be arrived at by applying this principle.

The principle of DIMINISHING RETURNS has two parts:

Physical Returns and Economic Returns.

Each of these parts should be understood as a section of this principle. As the students are discussing the results of increased physical input, they will soon recognize that it has an effect on PROFITS.

Examples of DIMINISHING PHYSICAL RETURNS and DIMINISHING ECONOMIC RETURNS are given separately and then the two are combined into the one principle.

PART I: DIMINISHING PHYSICAL RETURNS

III. INTRODUCTION:

Technique for Introducing Unit:

Develop a situation appealing to the students considering their background and experience. An example could be a boy who is hungry for a pizza. Other examples might be used such as cake, ice cream, etc. Chart 1 may be developed by the students (see page 17 for re-

production copy) to show how much hunger is satisfied with each bite of pizza. This can be done after discussing these leading questions.

Leading Questions:

1. How many of you have eaten pizza pie?
2. How many can you eat? Does the size of pizza make any difference?
3. How many bites does it take to get filled?
4. Which bite tasted best - the first or last one? Why?
5. Is there a point where additional bites made you feel uncomfortable?

From the chart we see that the first few bites of pizza gave much satisfaction. Much less pleasure was experienced from each subsequent bite.

Key Questions to Assist Students in Reaching Conclusions:

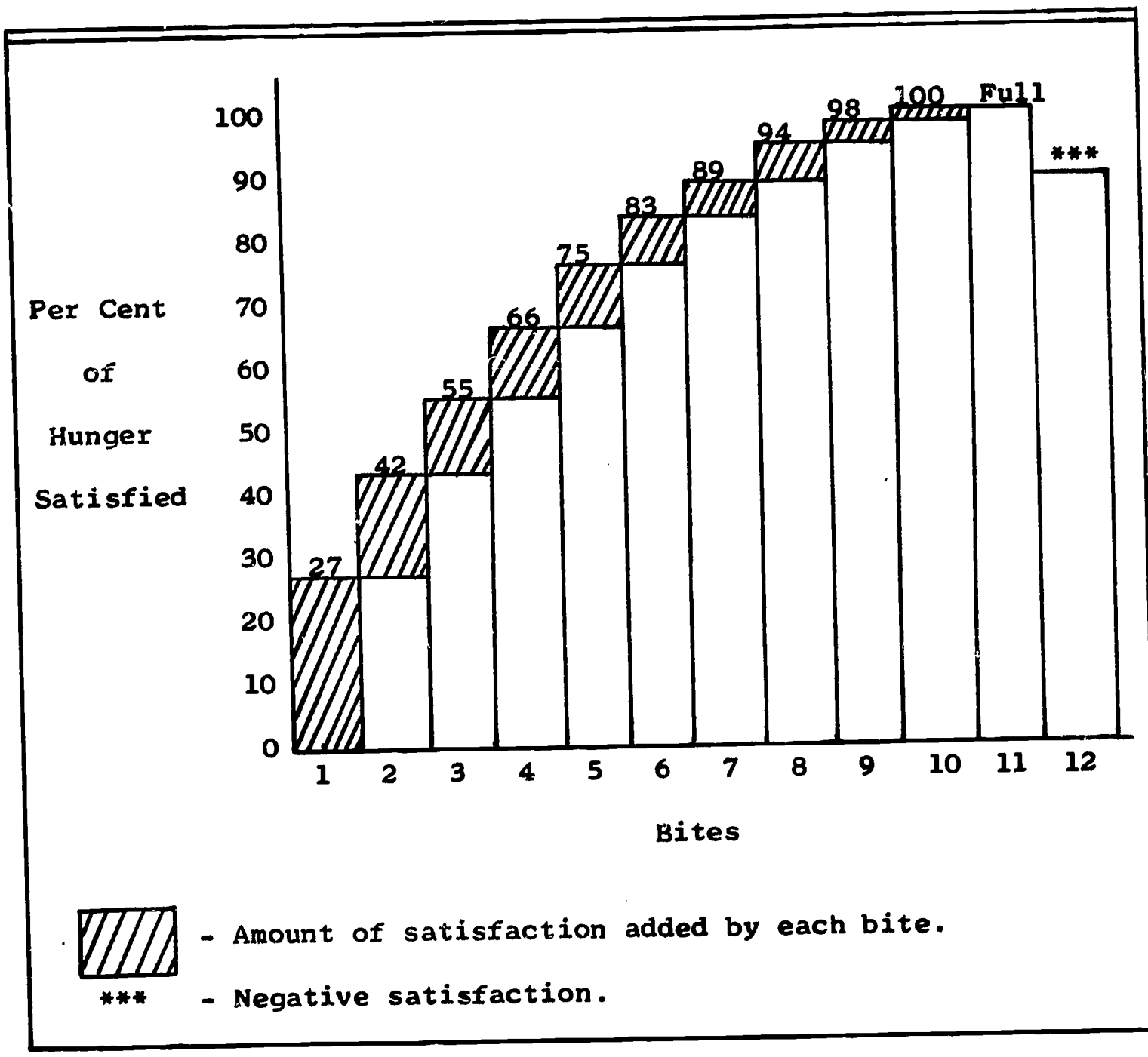
1. Should we stop after the first bite since it gives the most satisfaction?
2. What was gained by taking more bites?
3. Did the 11th bite still give some added satisfaction?
4. Was it worth the effort to take more bites up to the 11th?
5. Would there be a bite that would give him less satisfaction than the one before? Where?
6. For the greatest total satisfaction, where should he stop taking bites?

Conclusions to be Drawn From the Above Example:

To comprehend the diminishing rate of output (returns), students must understand the following conclusions.

CHART 1

CHART SHOWING SATISFACTION FROM EATING PIZZA



▨ - Amount of satisfaction added by each bite.

*** - Negative satisfaction.

1. That each bite represents an additional unit of input (pizza is eaten one bite at a time).

2. That each bite of pizza (unit of input) helps satisfy a part of a boy's hunger (unit of output).

3. That the added amount of satisfaction of the boy's hunger (marginal returns) diminishes as he nears the full mark (Diminishing Physical Returns).

4. At a certain point the amount of hunger satisfied (marginal returns) becomes negative with each additional bite (input). This point is after the boy is full (100%).

The above points will be developed more completely in the following (teaching-learning activities) section. The teacher should attempt to draw these from the students. However, do not give them to the students. Instead, list the conclusions offered by students. Keep a record of student-derived conclusions for future reference.

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The following examples and comments are included as suggestions to assist the teacher in developing a fuller understanding of the principle of diminishing physical returns with students.

The teacher must be careful not to give the students all the answers. Allow enough time for student discussion and individual thinking so that each member of the class will understand the facts shown in the following charts and statements. Question students in such a way that conclusions pertaining to each example can be drawn from students.

The following examples showing diminishing physical returns may be presented and discussed. In each of the examples a situation is developed with some leading questions to guide student thinking.

The charts, tables and key questions are tools designed to help students reach conclusions. The main conclusions to be developed for each example are listed. Each example will build on the previous ones until finally, we associate all the examples and accompanying conclusions and arrive at the principle.

Example #1. (Effects of Nitrogen on Corn Yield)

A boy is attempting to decide how much nitrogen to "plow down" for corn. His situation is similar to the research information found in Table 1.

Leading Questions:

1. How many of you plow down extra nitrogen for corn?
2. Will this increase yield? Why?
3. How much nitrogen should be plowed down?
4. Can we apply too much nitrogen? Why?
5. Is there an amount of nitrogen to apply which will give us the best yield?

Note: Lead questions should be stated in such manner that they will help the teacher to introduce Table 1.

/Note to Teacher:/ Ideas to be brought out with this example are the meaning of output, input, and diminishing returns. A student work sheet associated with this problem is located at the conclusion of this unit.

TABLE 1

EFFECT OF NITROGEN ON CORN YIELDS (MODIFIED)*

Lbs. Nitrogen Applied	Bushel - Yield
0	34
40	48
80	60
120	70
160	79
200	80
240	81

* From "Handbook of Ohio Experiments in Agronomy," 1957. Table #50.

Key Questions to Assist Students in Reaching Conclusions:

1. What happened when more nitrogen was applied? (Increased output--don't show marginal output too soon).

2. What other inputs (besides nitrogen) can be added to increase yield? (Show choice possibilities of inputs.)

3. How much increased yield did the farmer receive from the addition of the first 40 lb. of nitrogen?

4. What was the difference in yield between the first and second 40 lb. of nitrogen applied?

5. Did the last 40 lb. (200-240 lb.) give as much yield increase as the first (0-40 lb.)?

6. What happened to the increase in yield with each additional 40 lb. unit of nitrogen added? (It became less.)

7. What would happen if phosphorus was added?

Conclusions to be Drawn From Example #1:

1. Yield (output) was increased by adding more units of fertilizer (inputs). Definition: An input is any resource "put in" or added to increase production or output. Examples of inputs used by a farm operator are feed, labor, land.

2. The rate of increase in yield diminished as more units of inputs were added.

Example #2. (Output from Fertilizer)

The following example shows varying amounts of fertilizer (inputs) applied per acre of land in growing corn (output). Assume a situation involving 1 acre of land with uniform soil characteristics receiving a uniform level of labor and management. Assume that all of the resources (inputs) of land, labor, and management are constant, with only one input being variable (fertilizer).

Leading Questions:

1. How many lbs. of fertilizer should be used on corn?
2. Does highest yield give the greatest net profit per acre?
3. Is our main goal to make the highest yield possible?
4. Why?

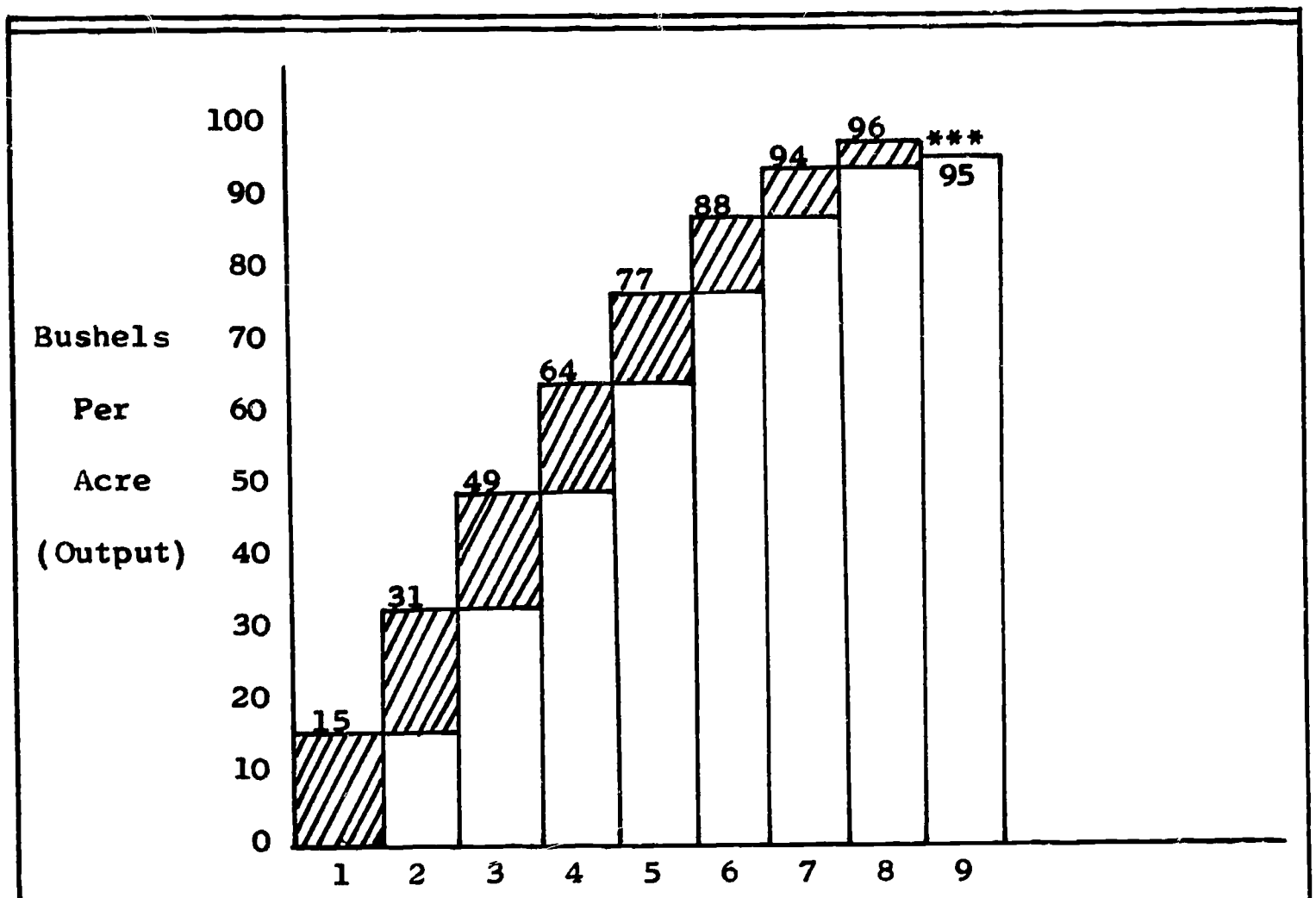
/Note to Teacher:/ Ideas to be brought out with this example are: inputs, outputs, marginal returns, and diminishing marginal returns. The key point to emphasize here is that the term marginal means added.

Key Questions to Assist Students in Reaching Conclusions:

1. Which input (land or fertilizer) was varied in Chart 2. (fertilizer) Can you name other examples of inputs?
2. What input was held constant (fixed)? Name others. (land)
3. Is the total yield from 8 bags of fertilizer greater than from 3 bags? Why?
4. Is the marginal (added) yield from the 8th bag as great as the marginal yield from the 3rd bag? Why? What was the

CHART 2

RESPONSE FROM FERTILIZER



- Amount of additional output added by each successive unit of input.

*** - Negative marginal yield.

added or marginal yield at each of these levels of fertilizer application?

5. Where should we stop applying fertilizer if we are only concerned with total yield or physical returns (no costs involved)? Why?

Conclusions to be Drawn From Example #2:

1. The yield (output) per added unit of fertilizer (input) declines after a stage of rapid increasing returns.

2. Continued application of fertilizer may keep increasing the total yield; however, after a certain point the amount of marginal (additional) increase in yield (output) becomes smaller with each successive level of fertilizer applied.

3. Additional yield or marginal yield is the amount added to the total product by the "pouring in" of one more unit of input.

4. When all resources except fertilizer were fixed (held constant), each additional unit of fertilizer input resulted in an increase in yield. However, at a certain point (depending upon the particular input-output relationship), additional units of fertilizer inputs resulted in a decrease in marginal yield.

5. Total yield is the output resulting from the addition of the total number of units of input.

6. Any input can be either a fixed or a variable resource depending on how it is used by the farm operator.

Example #3. (Effect of Feeding Dairy)

A farm businessman decides to increase the production from his dairy operation. From his dairy records, he finds the following facts to be true. A standard amount of good quality mixed hay is being fed throughout.

Explanation of Tables 2, 3, and 4: In Table 2, it is assumed that all inputs are held constant except grain. In Table 3, all

inputs are constant except supplement. And, in Table 4, the effects of the two inputs, grain and supplement combined, are shown.

Leading Questions:

1. Does the feed a cow eats influence her milk production?
2. How much grain and supplement should we feed a high producing cow?

Conclusions to Table 2:

1. Milk was increased by adding more units of grain.
2. The marginal increase in milk decreases after a given level of grain fed.

/Note to Teacher:/ At this point, the students may want to talk about the economics of more feed; but hold them back until the concept of Diminishing Physical Returns is established.

Conclusions to Table 3:

1. Milk was increased by the addition of more supplement.
2. The marginal increase in milk due to supplement also decreased.

/Note to Teacher:/ Ideas to be brought out by this example:

(a) marginal yield
(b) effect of two variables on diminishing yield.

Key Questions to Assist Students in Reaching Conclusions:

1. Did these cows give more milk when fed 25 lb. of grain than 5 lb. of grain?
2. Was the marginal milk production (additional) greatest with 5 lb. of grain or 25 lb. of grain?

TABLE 2

EFFECT OF GRAIN FEEDING ON MILK PRODUCTION

Grain Fed Lbs.	Milk Yield Lbs.	(for teacher only) Marginal Yield Lbs.
0	22	0
5	30	8
10	37	7
15	42	5
20	46	4
25	47	1

TABLE 3

EFFECT OF SUPPLEMENT ON MILK PRODUCTION

Supplement Fed Lbs.	Milk Yield Lbs.	(for teacher only) Marginal Yield Lbs.
0	22	0
0.3	28	6
0.6	31	3
0.9	32	1
1.2	32	0
1.5	32	0

TABLE 4

EFFECT OF COMBINED GRAIN AND SUPPLEMENT ON MILK PRODUCTION

Grain Fed Lbs.	Supplement Fed Lbs.	Milk Yield Lbs.	(for teacher only) Marginal Yield Lbs.
0	0	22	0
5	0.3	36	14
10	0.6	46	10
15	0.9	52	6
20	1.2	56	4
25	1.5	57	1

3. Did the marginal production go up, down, or remain constant with each unit of grain added?

4. When the two variables were combined (feed and supplement), did the marginal milk yield diminish at a different rate than when the variables were applied separately?

5. What are some other variable resources (inputs) that might be combined with units of feed?

Conclusions to be Drawn From Example #3:

1. When the two variables (feed and supplement) are applied to milk production, we get a combined effect which still shows the aggregate diminishing marginal returns concept.

2. All variable inputs must be identified and properly measured or faulty conclusions will be drawn.

3. The marginal output from feed decreases as the units of feed are added.

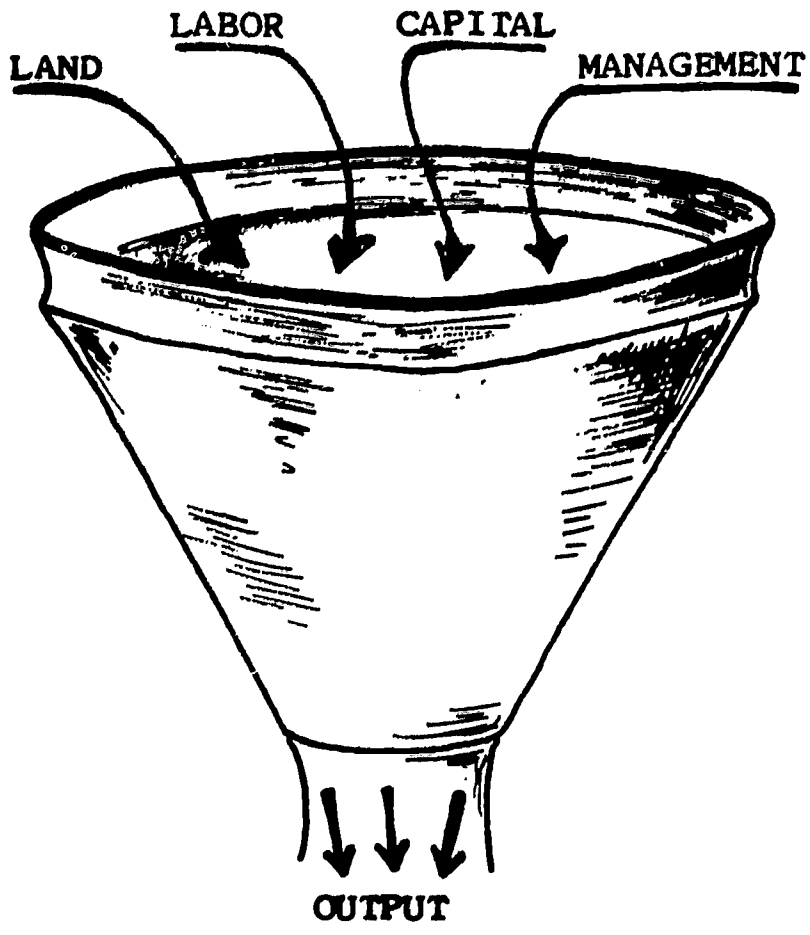
V. ASSOCIATION OF EXAMPLES:

At this point, the students should begin to see a relationship among the previous examples (pizza, nitrogen, fertilizer, feed). The students should understand the meaning of "marginal increase" of output (yield). The concept of "units of input" must be clear to them.

Teacher Activity

1. The teacher should bring together the foregoing examples and the student-derived conclusions for each previous example to help arrive at generalizations of the principles of diminishing returns.

2. Draw a funnel showing inputs of a farm business:



3. We might pose these questions:

   a. Is your hunger satisfied the same amount with each bite you eat?

   b. Is the production of corn increased the same amount with each unit of fertilizer applied?

   c. Did the milk production increase at the same rate with each added unit of feed?

VI. ARRIVING AT THE PRINCIPLE:

The diminishing returns principle is common to each of the previous examples and should be the ultimate conclusion the students obtain from this unit. But don't throw it out to them like feed and say, "Here it is -- write it down." Let it develop and evolve in their minds.

Teacher Activity

The students must understand the meaning of the words involved in explaining this principle.

1. Review with students new terminology evolving from this unit.

2. Ask students to present one more hypothetical example showing the principle (either written or oral).

3. Take the best situation and have students bring out the following facts:

   a. As units of a variable input are applied to a fixed input, the output increases.

   b. At a certain point each unit of variable input gives a diminishing return of marginal output.

4. You will want a definition something like: "The application of additional units of variable inputs to a unit of fixed input increases total output; but, after a certain point, the amount added to total output by each successive unit of variable input diminishes."

VII. STUDENT ACTIVITIES:

The time is now ripe for establishing this principle in the minds of the students. By applying this principle to realistic situations, the student will develop a fuller understanding.

The following are suggested student activities the instructor may wish to use.

Activity #1. Give students research report information and have them calculate marginal outputs resulting from each unit input added. As a result of interpreting this data, the students should be able to identify the point of diminishing physical returns. Table 5 is an example.

Activity #2. You will find the "Handbook of Ohio Experiments in Agronomy" a good source of charts showing diminishing returns. Using these data, have students determine marginal and diminishing returns.

Activity #3. Have students figure marginal increase and point of diminishing physical returns from research reports showing diminishing returns for livestock. A set of hypothetical figures showing milk-feed relationship could be as follows. Table 6 is an example.

Activity #4. Construction of graphs using the previous examples could be useful in developing student understanding. When they see the relationship of the total yield and marginal yield on a graph or chart they have constructed, it may be just the "trick" to fix the principle in their minds. Use both line and bar graphs. Some time may be spent in reviewing how to make a graph. Don't rush this part--it can have much learning value to the student. Prepared graph paper and colored pencils should be used to increase interest and learning. Use Chart 3 as a guide for this activity.

Activity #5. The following questions may be used for class discussion. The use of one of the previous production-factor charts or a simple basic graph as shown in Chart 3 should be on the board or a large chart available during the discussion.

TABLE 5

RATES OF SEEDING ALFALFA

Rate of Seeding Lbs.	Yield of Alfalfa Lbs.	(for teacher only) Marginal Yield Lbs.
4	2000	0
5	3000	1000
6	4200	1200
7	5000	800
8	5600	600
9	6000	400
10	6200	200
11	6300	100
12	6100	-200

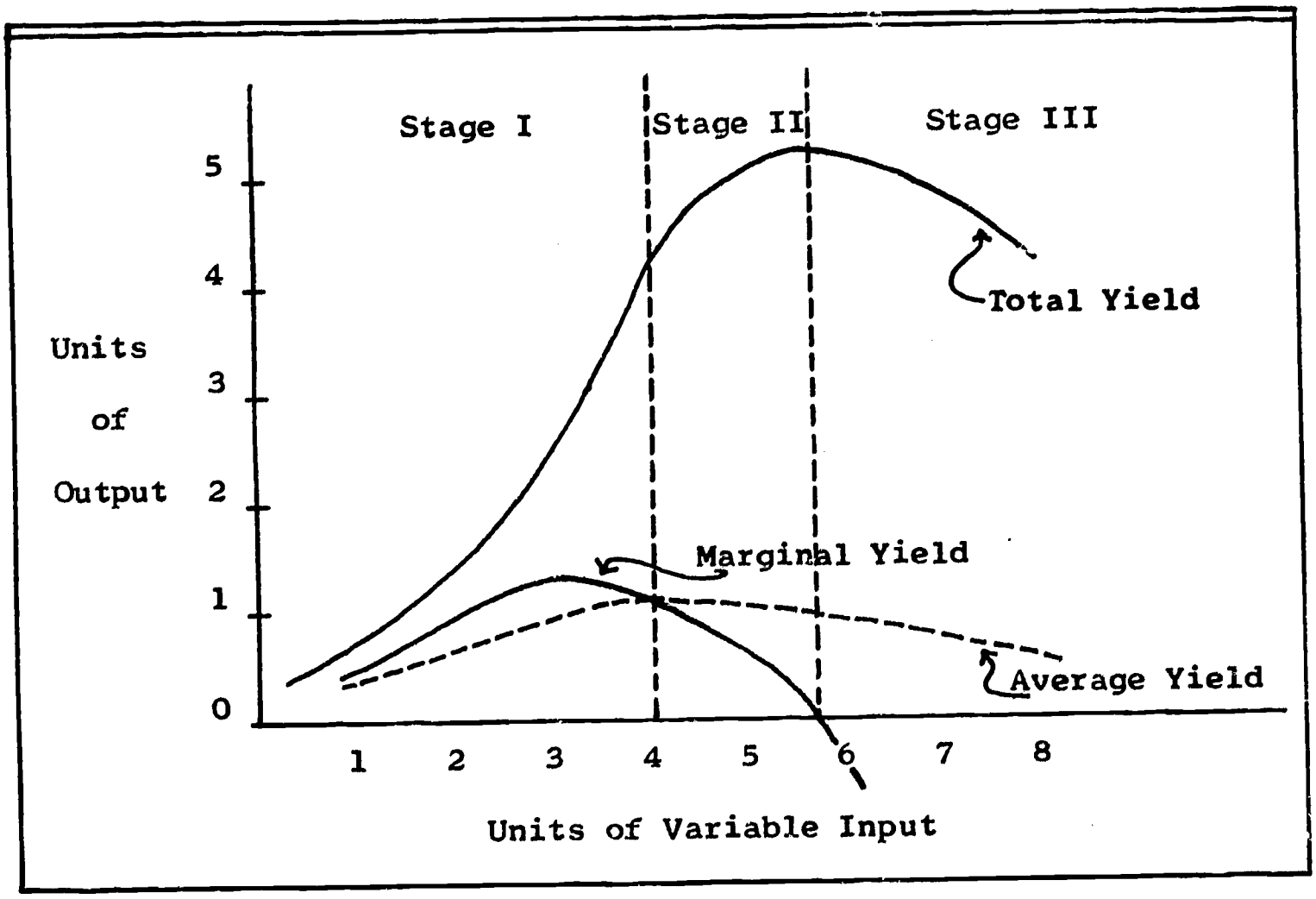
TABLE 6

EFFECT OF GRAIN FEEDING ON MILK PRODUCTION

Grain Fed Lbs.	Milk Yield Lbs.	(for teacher only) Marginal Yield Lbs.
0	22	0
5	30	8
10	37	7
15	42	5
20	46	4
25	47	1

CHART 3

SIMPLE PRODUCT - FACTOR CHART



/Note to Teacher:/

Stage I - Area of increasing returns.

- Point where average and marginal yield curves cross represents the optimum combination of variable input resources to fixed resource.

Stage II - Area of diminishing returns.

- Rational zone (or zone of decision).

- Extends to point where marginal yield becomes zero.

- Marginal yield is zero when total yield is at a maximum.

Stage III - Area of decreasing total returns.

- Marginal yield is negative.

Questions for Discussion:

1. At what point do we get the optimum combination of physical inputs?

2. How is the pounds of milk affected by the marginal yield?

3. What is the best level to apply physical inputs?

4. Should I apply fertilizer to my corn until I get no response?

5. Should I continue to increase my dairy cow's grain ration to the point where she will give her maximum production?

6. If the first unit of feed gave the most increase in milk production, should I stop because the added units give less increase in milk?

PART II: DIMINISHING ECONOMIC RETURNS

III. INTRODUCTION:

Technique for Introducing Unit:

Now that the student understands the diminishing physical returns concept, it should not be difficult to show the concept of diminishing economic returns. A few questions and discussion of the economics of profitable corn production should be sufficient to introduce this unit.

Leading Questions:

1. Should our main goal be to produce the highest possible yield?
2. What should our goal be? (maximum profit)
3. Can we increase profit from corn other than by increasing the yield? How? (reduce costs)

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The concept of diminishing economic returns is so closely related to diminishing physical returns that they can hardly be separated. At this point the student understands the diminishing returns principle as it relates to physical inputs and outputs. The student should now be guided in his discovery of the principle as it relates to economic input and output.

Each of the following examples is an expansion (showing effect of value) of previous illustrations.

Example #1. (Diminishing Economic Returns from Nitrogen)

After making a choice of how much nitrogen to "plow down," based on physical returns, a student is now ready to put values on the

input (nitrogen) and output (corn) to find the most profitable level to apply nitrogen. In Table 1, the value of corn is $1 per bushel and the nitrogen cost is 10¢ per pound.

Leading Questions:

1. What form of nitrogen might one use on corn? (bag - dry, liquid, gas)
2. How might we apply it?
3. Would the form and way it was applied affect the cost?
4. What is the cost per pound of nitrogen? (usually 7¢ - 11¢)

Note: Lead questions should be stated in such manner that they will help teacher introduce Table 1.

TABLE 1

EFFECT OF NITROGEN ON CORN

Nitrogen Applied	Yield	Added Yield	Nitrogen Cost @ 10¢/lb.	Added Yield @ $1.00/bu.	Added Return Above N Cost
0	34 bu.	0 bu.	$-0-	$-0-	---
40	48	14	4	14	$10
80	60	12	4	12	8
120	70	10	4	10	6
160	79	9	4	9	5
200	80	1	4	1	-3
240	81	1	4	1	-3

/Note to Teacher:/ Ideas to be brought out in this example:

(a) assigning values (dollars and cents) to inputs and outputs
(b) profitability
(c) diminishing profitability.

Key Questions to Assist Students in Reaching Conclusions:

1. What is the cost of each 40 lb. unit of nitrogen? ($4)

2. What was the added return above the cost of the first 40 lb. unit of nitrogen? ($10)

3. The second? ($8)

4. What happened to the amount of added return resulting from each unit of nitrogen? (It diminished) Why? (Physical yield went down.)

5. Did it ever become unprofitable to add more units? (Yes) Where? (After 160 lb. of N had been applied.)

6. Did maximum yield (81 bu.) give the greatest net return? (No) Why? (After 160 lb. of N the marginal cost was greater than marginal returns.)

Conclusions to be Drawn From the Above Example:

1. Values in terms of dollars and cents can be applied to the diminishing returns principle giving profitability of a variable input.

2. Additional units of input diminish in profitability to a point where they become unprofitable.

3. The point where a variable input (cost) is no longer profitable is when it equals marginal returns. (MC = MR)

4. The addition of units of input beyond the point where they equal units of returns is unprofitable.

Example #2. (Diminishing Marginal Return from Fertilizer)

Chart 1 illustrates the effects of varying amounts of fertilizer applied per acre of land in producing corn.

Leading Questions:

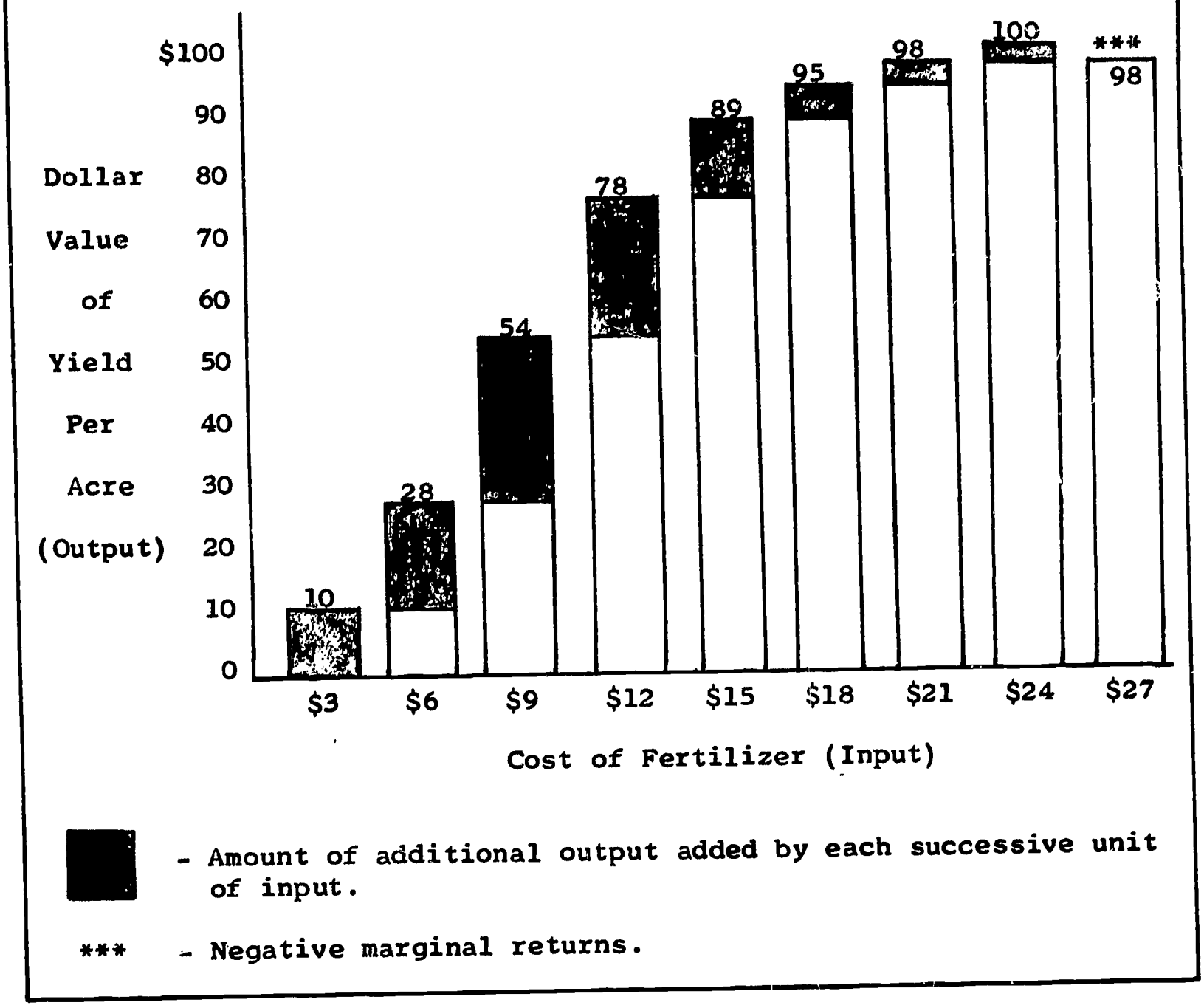
1. How many dollars worth of fertilizer should you put on an acre of corn?

/Note to Teacher:/ Ideas to be brought out by this example:

(a) effect of value on input and output relationship
(b) effect of marginal cost and return on total cost and return.

CHART 1

RESPONSE FROM FERTILIZER



■ - Amount of additional output added by each successive unit of input.

*** - Negative marginal returns.

Key Questions to Assist Students in Reaching Conclusions:

1. Is the total return from $24 of fertilizer greater than from $9 ? Why? (Yes; the total return in terms of dollar yield is greater.)

2. Is the marginal returns from $24 of fertilizer as great as the marginal returns from $9 of fertilizer? Why? (No; the marginal returns begin to decline after the $9 application.)

3. Which input (land or fertilizer) varied on this chart? (fertilizer - this was the only variable.)

4. What inputs were held constant? (land, labor and all other inputs)

5. Based on Chart 1, where should we stop applying fertilizer to give the greatest economic returns? (At the $24 level)

Conclusions to be Drawn From Example #2:

1. The returns (output) per added unit of fertilizer (input) decline after a stage of rapid increasing returns.

2. Adding dollars worth of fertilizer increases the total returns, although the amount of marginal (additional) increase from each application of input becomes smaller.

3. Additional returns or marginal returns is the amount added to the total return by the "pouring in" of one more unit of input.

4. When all resources except fertilizer were fixed (held constant) each added unit of fertilizer resulted in an increase in returns up to a certain point.

5. Total returns is the output resulting from the sum of the units of input.

6. A diminishing rate of marginal return takes place before a maximum profit is realized.

Example #3. (Effect of Feeding Dairy)

After considering physical production, a dairy farmer wishes to determine the most economic level for feeding his dairy cows to

receive maximum profit. The conditions of this example are the same as Example #3 in Diminishing Physical Returns except that values have been assigned in terms of dollars and cents. (See Table 2)

Leading Questions:

1. How much should one spend to feed a high producing cow?

2. Is there a point of maximum returns from money spent on feed?

/Note to Teacher:/ Ideas to be brought out by this example:

(a) marginal returns
(b) effect of two variables on diminishing return.

Key Questions to Assist Students in Reaching Conclusions:

1. As more was spent on grain, what happened to the milk returns? (increased)

2. At what cost were the marginal milk returns the least? (With the combination of grain and supplement?)

3. What did the marginal returns tend to do? (Decline after the first application.)

4. What are some other variable resources (inputs) that might be combined with feed cost in producing even greater returns than are shown in Table 2? (antibiotics and insecticides)

5. What would result if our decision to spend more on feed was based on a situation where an unknown variable was working? (It would be more difficult to establish the point of optimum profit.)

6. Where did the combination of feed and supplement give us the greatest profit? (second application)

7. At what point should one stop spending more for feed? (at 60¢ grain, 8¢ supplement)

Conclusions to be Drawn From Example #3:

1. When two or more variable costs are applied to producing

TABLE 2

EFFECT OF COMBINED GRAIN AND SUPPLEMENT ON MILK RETURNS

Grain at 3¢ per # -- Supplement at 7¢ per #						
Grain		Supplement		Milk Returns In $	(for teacher only) Marginal Returns In $	Dollar Returns Over Feed Cost
# Lbs.	Cost	# Lbs.	Cost			
0	.00	0	.00	1.10	.00	1.10
5	.15	0.3	.02	1.80	.70	1.63
10	.30	0.6	.04	2.30	.50	1.96
15	.45	0.9	.06	2.60	.30	2.09
20	.60	1.2	.08	2.80	.20	2.12
25	.75	1.5	.10	2.85	.05	2.00

a product (milk), we get a combined effect which shows the aggregate diminishing returns principle.

2. All variable resource costs must be identified and properly measured in a diminishing returns situation or faulty decision-making will result.

3. The marginal returns from feed decreases as the feed cost increases.

/Note to Teacher:/ Here is an opportunity to associate this principle with an agricultural business other than farming. It will give the students an idea of the broad application of these principles.

Example #4. (Returns from Farm Machinery Advertisement)

A machinery dealer decided to increase his business through advertising. After running a machinery advertisement for five weeks, he summarized the results and used them to decide how much advertising to use in the future. The teacher should assume that there is no seasonal influence affecting the demand for machines. (See Chart 2)

Leading Questions:

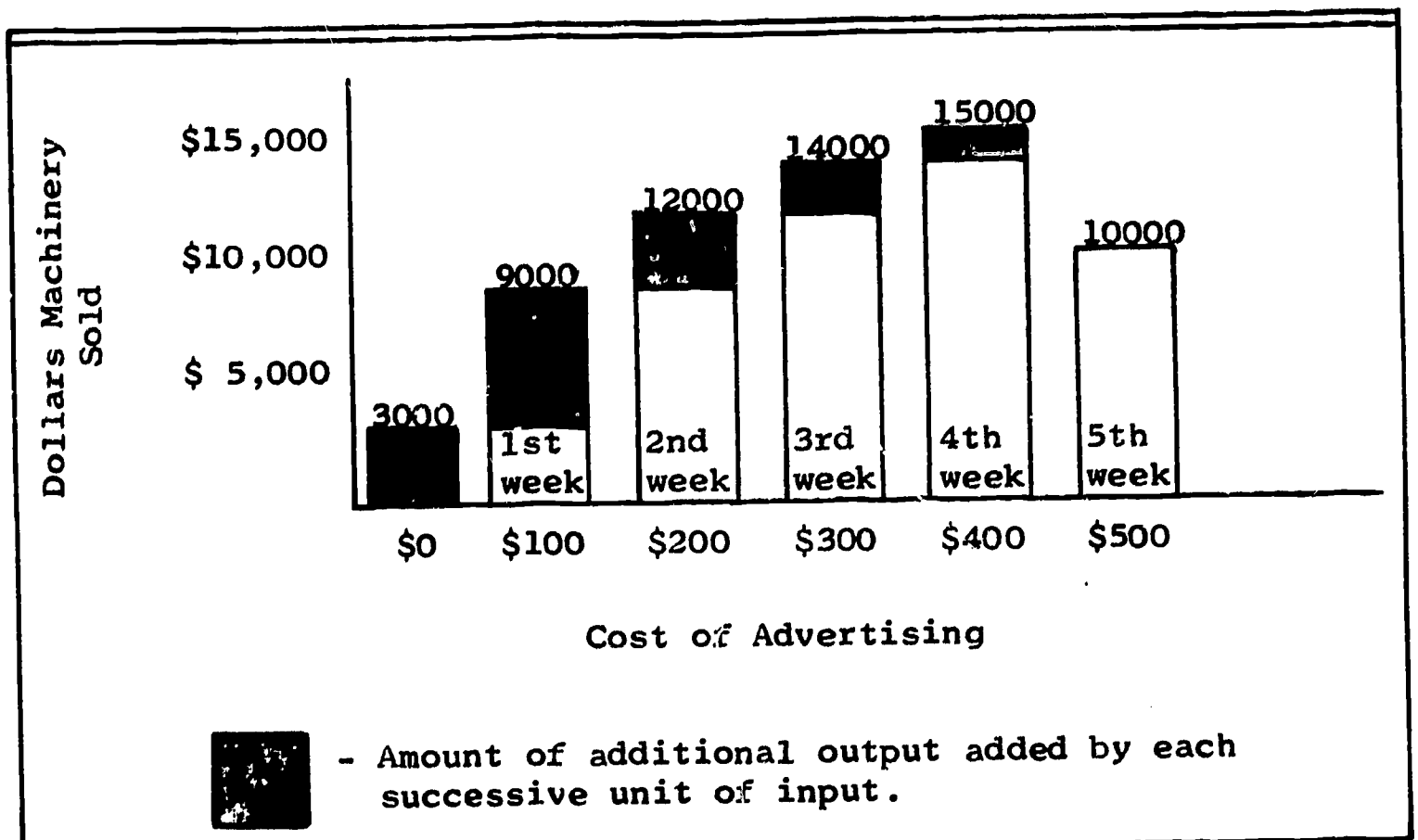
1. We have seen how a farm manager can increase corn returns. Can a businessman increase his returns in a similar way? How?

2. How could a machinery dealer increase the volume of income from equipment sales? (Sell more equipment through advertisement, large stock of equipment, etc.)

3. If you were a machinery dealer how much would you spend for advertisement? (Continue to advertise as long as the cost is covered by additional equipment sales.)

CHART 2

EFFECT OF ADVERTISEMENT ON SALES



/Note to Teacher:/ Ideas to be brought out by this example:

(a) marginal returns
(b) average returns
(c) the effect of more than one variable on total output.

Key Questions to Assist Students in Reaching Conclusions:

1. Did the advertisements increase economic returns?

2. Was the increase the same each week?

3. How much additional gross sales was realized each time another unit of $100 was spent on advertisement? ($6000, $3000, $2000, $1000, minus $5000)

4. What was the average gross sales for each $100 spent? ($63,000 + $500 = $126)

5. What happened to total sales? marginal sales? (Sales increased up to $400 invested in advertisement; marginal sales were the greatest with the first $100 spent on advertisement then declined.)

6. What was gained by further advertisement? (Increased economic returns but at a diminishing rate)

7. Where should he stop advertising? ($400 level) Why?

8. What was the variable input? (Dollars of advertisement)

9. Could there have been other variable inputs? (Yes)

10. What would happen to his sales if he hired two new salesmen and built a new show room? Would these be considered other variables?

Conclusions to be Drawn From Example #4:

1. The inputs in cost of advertising resulted in an increase in total sales, but marginal increase diminished after the first $100 was spent for advertising.

2. The average income (output), which is the total sales divided by the total cost of advertisement, decreased after the second $100 cost.

3. Marginal increase in sales declined after the initial advertisement and eventually became negative after the fourth $100 was spent.

V. ASSOCIATION OF EXAMPLES

Students should be grasping the relationship among the previous examples. They should understand that by attaching cost and price to the physical inputs and outputs that the principle of diminishing returns becomes useful in decision-making. The student should understand that to obtain the most profitable returns, he must increase production until marginal cost equals marginal returns. (MC = MR)

Refer again to the funnel showing inputs and outputs of a farm business. Attach cost and price to make the example realistic.

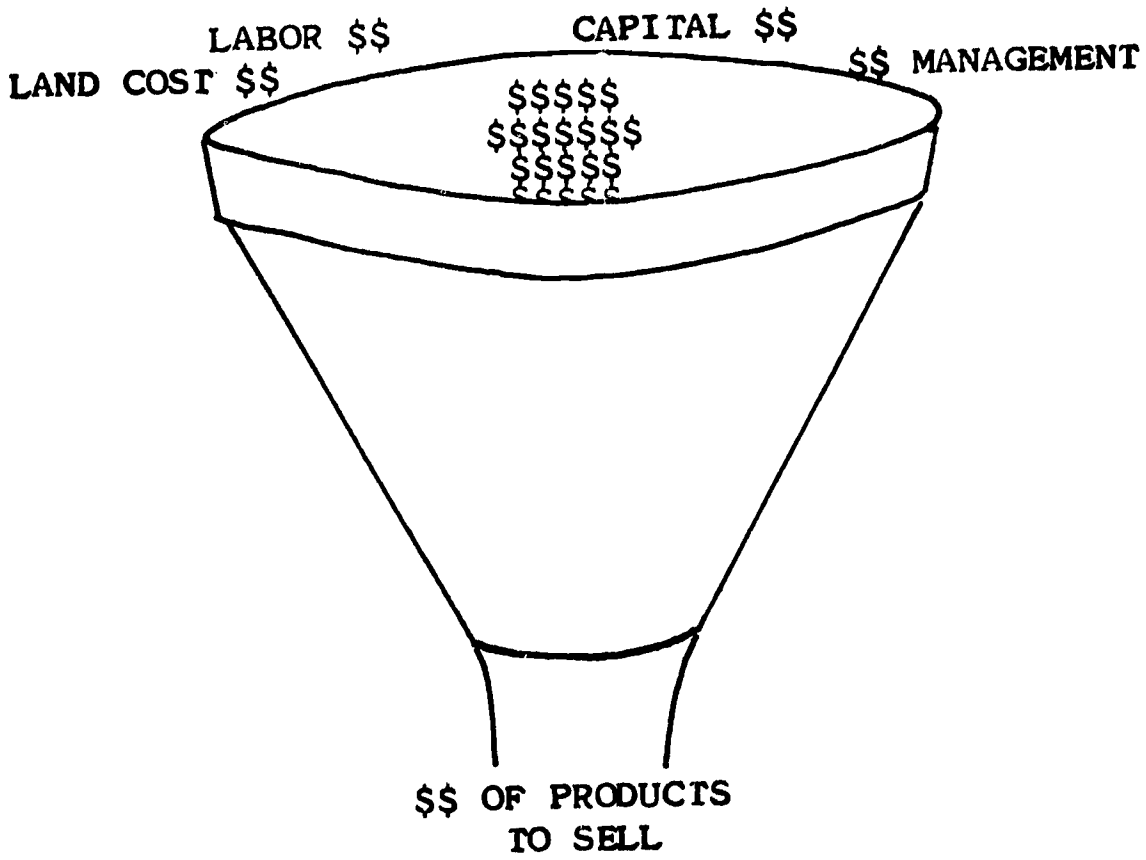
At this point the teacher should bring together the foregoing examples and student-derived conclusions as resolved from all the examples presented. These conclusions should be associated to the principle of diminishing returns. The following questions may also be used to show these associations.

Questions to Pose:

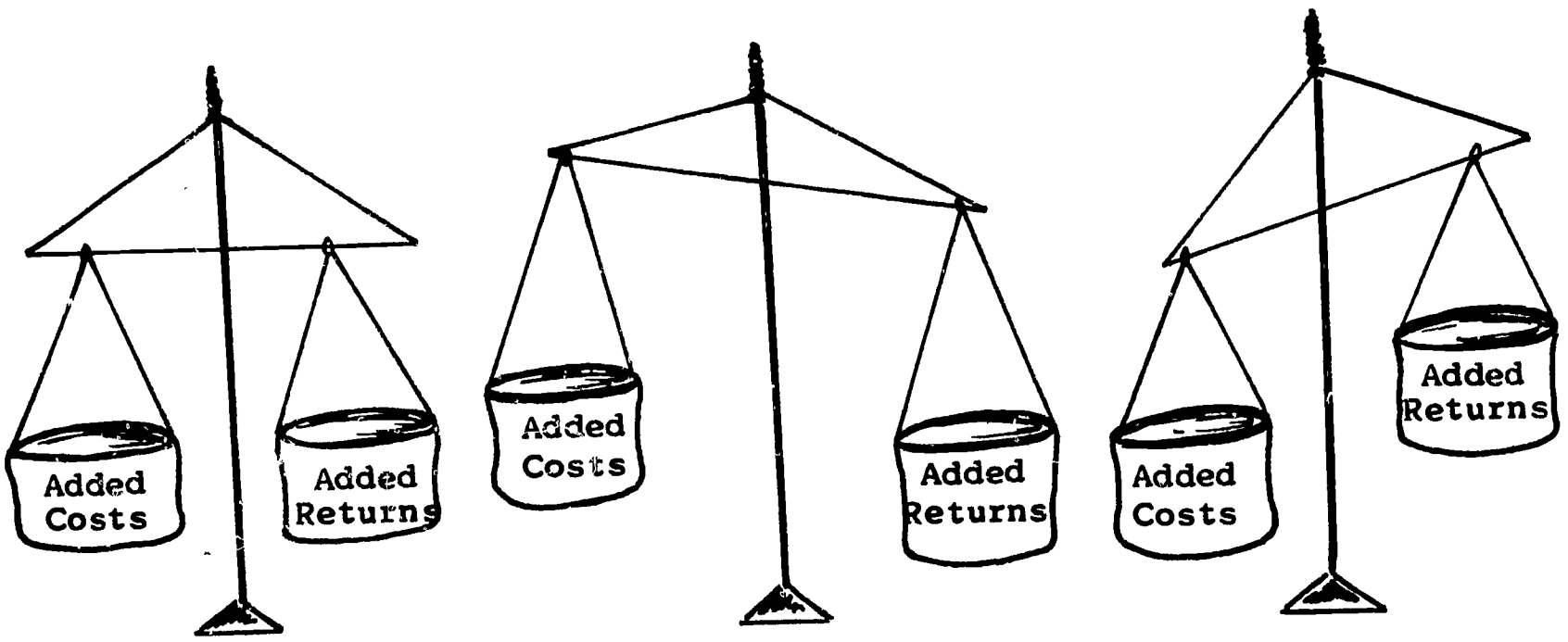
1. Is the return from corn increased the same amount with each unit cost of fertilizer applied?
2. Did the returns from milk increase at the same rate with each added cost of feed?
3. Did the return from machinery sales increase at the same rate with each additional amount spent for advertising?

VI. ARRIVING AT THE PRINCIPLE

The principle of diminishing returns is at work in each of the previous examples and is the conclusion the students should arrive



Weigh and Decide:



(A) No Added Profit

(B) Added Profit

(C) Loss

at as it has evolved in this unit. This principle applies in all the examples just as the force of gravity acts in Columbus as it does in Boston or London.

Teacher Activity

To be certain students understand the meaning of the words involved in explaining the principle, the following is suggested:

1. Review the terminology in view of their language and have them make specific application in real life situations.

2. Take an example students suggest and bring out the following facts:

   a. As units of a variable input are applied to a fixed input, the output increases.

   b. At a certain point each unit of variable input gives a diminishing return of marginal output.

3. A specific definition of the principle is: "After a certain point, the economic returns for each successive unit of variable resource added to a unit of fixed resource tends to decline. However, the farm manager, in order to secure maximum profits, should continue adding variable resources to fixed resources as long as marginal returns are greater than marginal costs."

VII. STUDENT ACTIVITIES

To further establish this principle in the minds of the students the following activities are suggested:

Activity #1. Provide research information to the students and have them calculate marginal returns resulting from each unit of cost added. They should also be able to identify the point of diminishing economic returns. (See Table 3)

Activity #2. Charts could be developed using livestock and machinery cost and returns to show the principle at work in these

TABLE 3

COST OF SEEDING ALFALFA

Cost of Seeding in $	Returns of Alfalfa in $	(teacher only) Marginal Returns in $
$2.00	$30.00	$ 0
2.50	45.00	15.00
3 00	63.00	18.00
3.50	75.00	12.00
4.00	84.00	9.00
4.50	90.00	6 00
5.00	93.00	3.00
5.50	94.50	1.50
6.00	91.50	-3.00

TABLE 4

EFFECT OF GRAIN COST ON MILK RETURNS

Grain Cost in $	Milk Returns in $	(teacher only) Marginal Returns in $
0	1.10	0
.15	1.50	.40
.30	1.85	.35
.45	2.10	.25
.60	2.30	.20
.75	2.35	.05

areas. A set of hypothetical figures on milk-grain relationships is shown in Table 4. Have students interpret results of this table by determining marginal and diminishing returns.

Activity #3. The following questions may be used for class discussion. Use the previous production-factor chart (Chart 3--Part I) for illustration.

/Note to Teacher:/ The three stages are the same as when applied to diminishing physical returns.

Questions for Discussion:

1. What is the best level to apply inputs? (Stage I, because of marginal returns per unit of input being the greatest.)

2. At what point do we get the optimum combination of economic inputs? (Within the second stage.)

3. Should I continue to apply fertilizer to my corn until I get no additional returns? (Stop just before that point; MC = MR.)

4. Should one continue to buy additional feed for the dairy cow to the point where she will give her maximum production? (No.) Why? (Marginal costs will be greater than marginal returns.)

5. If the first 15¢ spent for feed gave the most increase in milk returns, should we stop because the added units give less increase in returns? Why?

STUDENT WORK SHEET

IDENTIFYING DIMINISHING RETURNS

EFFECT OF NITROGEN ON CORN YIELDS (MODIFIED)*

Lbs. Nitrogen Applied	Bushel - Yield
0	34
40	48
80	60
120	70
160	79
200	80
240	81

* From "Handbook of Ohio Experiments in Agronomy," 1957. Table #50.

Answer the following questions using the table above:

1. What happened to the yield when more nitrogen was applied?

2. How much was the yield increased from the addition of the first 40 lb. of nitrogen?

3. What was the difference in yield between the first and the second 40 lb. of nitrogen applied?

4. Did the last 40 lb. (200-240 lb.) increase the yield as much as the first (0-40 lb.)? Why?

5. What effect did <u>each</u> additional 40 lb. unit of nitrogen have on yield?

STUDENT WORK SHEET

DETERMINING OPTIMUM FEEDING LEVELS

Sometimes there is more than one variable input at work in a given situation at the same time. These need to be considered together.

A Dairyman Looks At His Feeding Program:

(Use Tables 2, 3, and 4 in Part I to answer the following questions.)

From Table 1:

1. Was milk production increased by adding more grain?

2. Was the increase in milk production as great when grain was increased from 10 to 15# as it was when the grain was increased from 5 to 10#?

3. Would it seem wise to feed the 25# of grain? Why?

From Table 2:

4. Did the milk production increase every time the supplement was increased?

5. What level of supplement gave the greatest increase in milk production?

6. Would it seem wise to feed the 1.5# of supplement? Why?

From Table 3:

7. At what level of grain and supplement feeding was the increase in milk production the greatest? _____grain _____supplement

8. Did milk production continue to increase as the amount of both grain and supplement fed were increased?

9. How much was the increase in milk production when the grain was increased from 20 to 25# and the supplement was increased from 1.2 to 1.5#?
   Would it seem wise to make this last increase?

10. What do you think would be the best level of grain and supplement feeding? Why? _____# grain _____# supplement

STUDENT WORK SHEET

IDENTIFYING THE POINT OF DIMINISHING ECONOMIC RETURNS

EFFECT OF NITROGEN ON CORN YIELDS (MODIFIED)*

Lbs. Nitrogen Applied	Bushel - Yield
0	34
40	48
80	60
120	70
160	79
200	80
240	81

* From "Handbook of Ohio Experiments in Agronomy," 1957. Table #50.

1. Did the increase of each additional 40# of nitrogen increase the yield of corn? _____

2. How much was the increase in yield from the addition of the first 40# of nitrogen? _____
   How much was the increase in yield from the last 40# added? _____

3. How much was the increase in yield when the nitrogen application was increased from 80 to 120# per acre? _____

4. Find the return for additional investment: When nitrogen costs 10¢ per pound and corn is worth $1 per bushel.

Lbs. Nitrogen Added	Cost of Added Nitrogen	Value of Increased Yield	Net Return
40#	$4.00	$14.00	$10.00
40 to 80#			
80 to 120#			
120 to 160#			
160 to 200#			
200 to 240#			

5. At what application level does increased yield not pay for the cost of another unit of 40 lbs. of nitrogen? _____

STUDENT WORK SHEET

USING THE PRINCIPLE OF DIMINISHING RETURNS

Fill in the table below with grain priced at 3¢ per lb. and supplement priced at 7¢ per lb.

ECONOMIC FACTORS OF COMBINED GRAIN AND SUPPLEMENT FEEDING

Grain Lbs.	Grain Cost	Supplement Lbs.	Supplement Cost	Milk Returns $	Added Returns $	Returns Over Feed Cost $
0	0	0	0	1.10	0	1.10
5	____	0.3	____	1.80	____	____
10	____	0.6	____	2.30	____	____
15	____	0.9	____	2.60	____	____
20	____	1.2	____	2.80	____	____
25	____	1.5	____	2.85	____	____

1. Did the returns from milk continue to increase as more was invested in grain and supplement? _____

2. At what level of grain and supplement was the added (or Marginal) returns the greatest? _____grain _____supplement
   the least? _____grain _____supplement

3. At what level of grain and supplement feeding was the return over feed cost the greatest? _____grain _____supplement.

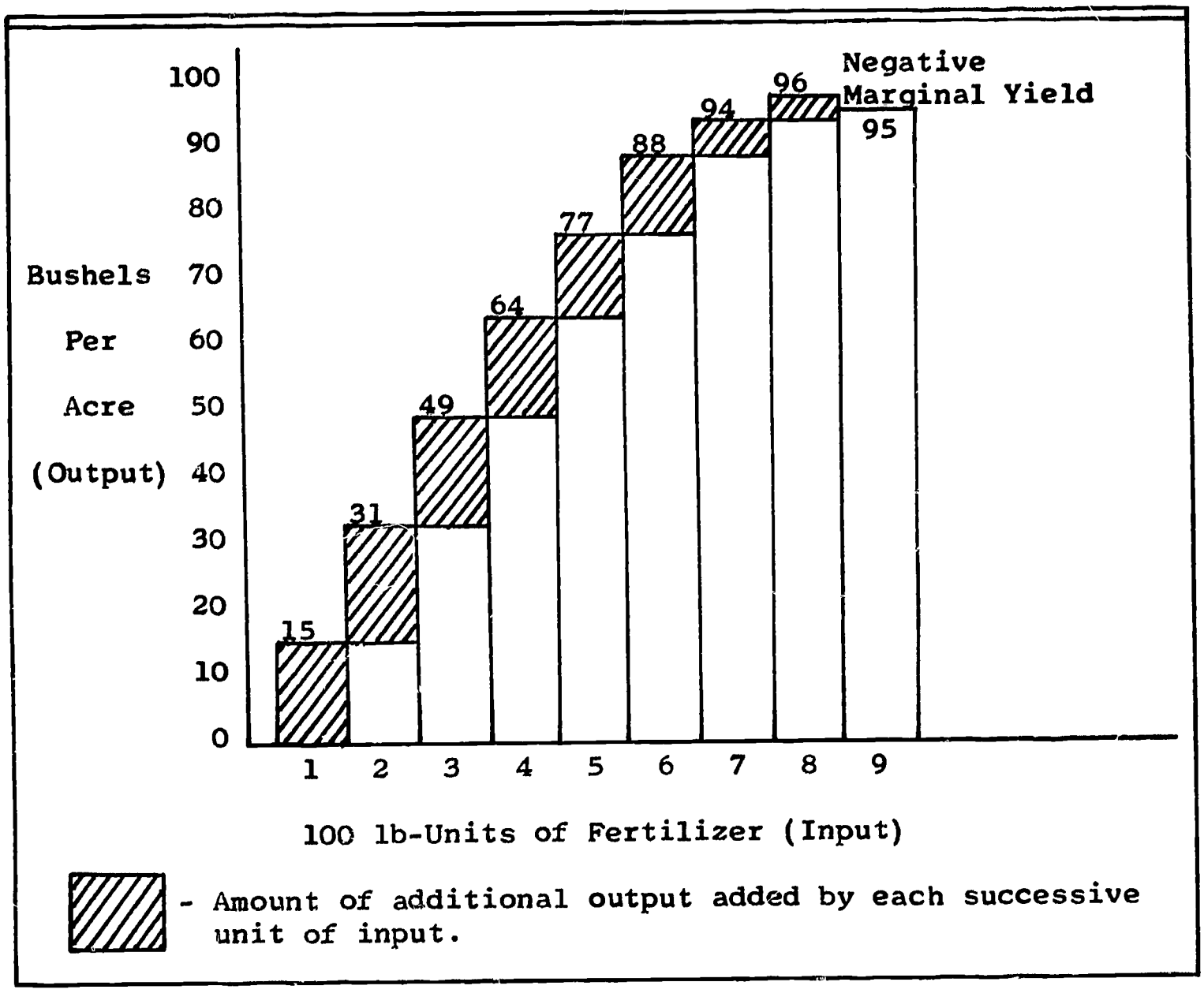
4. What was the cost (both grain and supplement) when 15# of grain and 0.9# of supplement was fed? _____

5. At what point should one stop spending money for additional feed?
   _____# grain _____# supplement

STUDENT WORK SHEET

DETERMINING THE MOST PROFITABLE YIELD

RESPONSE FROM FERTILIZER



From the above chart:

Compare the net profit per acre for the 94 bu. and 96 bu. per acre yields.

	94 bushel	96 bushel
Income per acre with corn at $1 per bushel	_____	_____
Cost of fertilizer per acre with fertilizer at $4.20 per 100# unit	_____	_____
Net profit per acre	_____	_____

THE GOAL SHOULD NOT ALWAYS BE THE HIGHEST YIELD BUT THE MOST PROFITABLE YIELD

SAMPLE QUIZ ON DIMINISHING RETURNS

Answer the questions below by using the following table:

EFFECT OF GRAIN FEEDING ON MILK PRODUCTION

Grain Fed Lbs.	Milk Yield Lbs.	Increased or Marginal Milk Yield With Each 5# Feed Added
0	22	
5	30	
10	37	
15	42	
20	46	
25	47	

1. What was the increase in milk production when the feed was increased from 0 to 5 pounds? _____

2. What was the marginal return in milk production when the feed was increased from 15 to 20 pounds? _____

3. With the cost of grain at 3¢ per pound and the value of milk at 5¢ per pound, where would the point of MC = MR be? _____

4. How much greater was the value of the increase in milk than the cost of the feed when feed was increased from 5 to 10#? _____¢

5. Is the maximum yield of milk always the most profitable? _____ Why?

6. Should the amount of grain fed be increased beyond the 15# level? _____ Why?

7. State your definition of the principle of diminishing returns.

8. Illustrate the principle of diminishing returns from your own experiences. You may use the other side of this quiz sheet.

SAMPLE QUIZ ON DIMINISHING RETURNS

Answer the questions below by using the following table:

EFFECT OF INCREASED RATES OF SEEDING ALFALFA

Rate of Seeding Lbs.	Yield of Alfalfa Lbs.	Marginal Yield Lbs.
4	2000	0
5	3000	_____
6	4200	_____
7	5000	_____
8	5600	_____
9	6000	_____
10	6200	_____
11	6300	_____
12	6100	_____

1. At what seeding rate was the increase in yield the greatest?
   From _____# to _____#.

2. At what rate of seeding did the yield decrease?
   From _____# to _____#.

3. With the cost of seed at 40¢ per # and the value of hay at $20 per ton, would it pay to increase the seeding rate from 10 to 11# ? _____

4. With the above prices, the increase in seeding rate from 5 to 6# would cost only 40¢. What is the net return on this investment with hay valued at $20 per ton? $_____

5. By figuring the value of the increased yield, what is the best seeding rate? _____#

6. Was the increase in yield greater at the lower rates of seeding or at the higher rates of seeding? _____ Why?

7. State your definition of the principle of diminishing returns and give an example of it.

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FIXED-VARIABLE COSTS

Suggested Teaching Time: 1 week

Terms Used In This Unit:

Capital: An aggregation of economic goods used to promote the production of other goods.

Depreciation: Decline in value of an asset due to such causes as wear, age, obsolescence, etc.

Fixed Cost of Production: That monetary obligation incurred by the firm, in the short run, which does not vary with the level of production; such as depreciation, taxes, etc.

MC = MR: Marginal (additional) costs equal Marginal (additional) returns.

Unit of Input: A factor of production or basic resource. It may be fixed or variable in nature.

Unit of Output: Unit of production resulting from the combination of variable and fixed inputs.

Units of Production: Factors that enter into the production process.

Variable Cost of Production: One of the units of production that varies in the production process; for example, gasoline used in a car depending on the amount the car is used.

I. TEACHING UNIT: PRINCIPLE OF FIXED-VARIABLE COSTS

II. UNIT OBJECTIVES:

A. To discover that all costs of production can be classified as a fixed or a variable cost.

B. To discover that total fixed costs of an enterprise will not vary with units of output.

C. To discover that total variable costs will vary with the size of the enterprise.

D. To identify that fixed costs per unit of production will decline by spreading fixed costs over more units of production.

E. To identify that length of time determines whether a cost is fixed or variable.

F. To discover that a best combination of costs (fixed and variable) can be selected for an enterprise or enterprises which will return maximum profits.

III. INTRODUCTION:

Technique for Introducing Unit:

Develop a situation that will be appealing to the students considering their background and experience. An example could be the cost of operating a car. Other examples could be the cost of owning a house, a tractor or a boat. You may develop a list of the costs of operating a car on the board by using these leading questions.

Leading Questions:

1. How many of you own a car?

2. How many of you drive the family car?

3. If you drive the family car, what costs do you have to pay? (Develop a list on the board.)

4. If you own a car, what costs do you have to pay? (Develop a list on the board.)

5. Are all the costs in operating a car alike?

6. What will be the cost of oil if you do not drive the car next year?

7. What will be the interest cost at 6% on $2000 if you do not drive the car next year?

8. What are additional fixed and variable costs associated with owning and operating a car?

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The following examples and information may be used in developing a better understanding of the principle of fixed-variable costs with the students.

Example #1. (Identifying Fixed and Variable Costs)

The distinction between fixed and variable costs may be shown by using the following example of owning and operating a car.

Leading Questions:

1. How much does it cost per year to operate a car? (Attach values to the list of costs developed in the introduction.)

/Note to Teacher:/ List all fixed and variable costs of owning a late model car on the board. If possible, use the car that a member of the class has just purchased. Ideas to be brought out in this example are the differences between fixed and variable costs. After all costs have been identified, have students attempt to classify these costs either as fixed or variable.

Costs of Owning and Operating a $3000 Car For One Year:

Depreciation: $3000 - $500 (salvage value) ÷ 5 yrs. . . .	= $500
Interest: $1500 @ 6% - average investment over life of car	= 90
Insurance	= 80
License and tax	= 20
Gas: 20,000 miles @ 16 mi/gal., 1250 gal. @ 32¢	= 400
Oil and Grease	= 80
Repairs	= 240

Key Questions to Assist Students in Reaching Conclusions:

1. How are the fixed costs different from the variable costs? (Fixed costs are those costs incurred whether or not production takes place. Variable costs are those costs that change as output changes.)

2. What determines how much the fixed costs per year will be? (Original cost and length of service)

3. Will the total fixed costs change on the car as it is driven more? (No)

4. What determines how much the variable costs will be? (Amount of use)

5. Will the variable costs occur if the car is not driven? (No)

6. Will the variable costs change from year to year? (Yes)

Conclusions to be Drawn From Example #1:

1. All fixed costs listed above must be met regardless of how many miles are driven.

2. Total fixed costs remain constant regardless of the amount of use.

3. Variable costs occur if use (Production) takes place; if use (Production) does not occur, variable costs are zero.

4. Variable costs are not constant but vary with amount of use.

Example #2. (Depreciation of a Tractor - A Fixed Cost)

Since depreciation is a significant cost involved in the total fixed costs of any item, this example is included to explain it.

Leading Questions:

1. How long will a tractor last?
2. Does it decrease in value each year?
3. What is this decrease called? (Depreciation)

/Note to Teacher:/ Have students calculate the annual depreciation of the tractor in the following example. Let them attempt the solution alone. Ask for answers. Then have them use the formula: Annual Depreciation = Cost - Salvage Value ÷ Years of Life

Problem: You have just purchased a tractor for $4,000 with an expected life of 7 years and a salvage value (value at the end of useful service) of $500. What will be the annual depreciation cost of owning this tractor?

Key Questions to Assist Students in Reaching Conclusions:

1. How much was the annual depreciation? ($500)
2. Can depreciation be estimated each year? Why? (Yes, because it does not vary directly with the amount of use.)
3. What are other fixed costs? (interest, taxes, insurance and repairs)
4. Could they be estimated each year? Why? (Yes, because they are annual fixed costs, also.)

Conclusions to be Drawn From Example #2:

1. Depreciation is an annual fixed cost.
2. Depreciation can be calculated for each year of life.
3. Total fixed costs can be calculated annually.

Example #3. (Depreciation Per Hour For a Tractor)

Sometimes it may be important to figure the depreciation cost of the tractor based on the hours of use during the year. This may be a consideration in determining whether to own equipment, lease it, or hire custom work done.

The student should understand that this fixed cost of depreciation can be spread out over many units of production or many hours of use of a piece of equipment.

Leading Questions:

1. Will the total fixed costs be the same each year?
2. Will the fixed costs per tractor hour change depending on the number of hours the tractor is used?

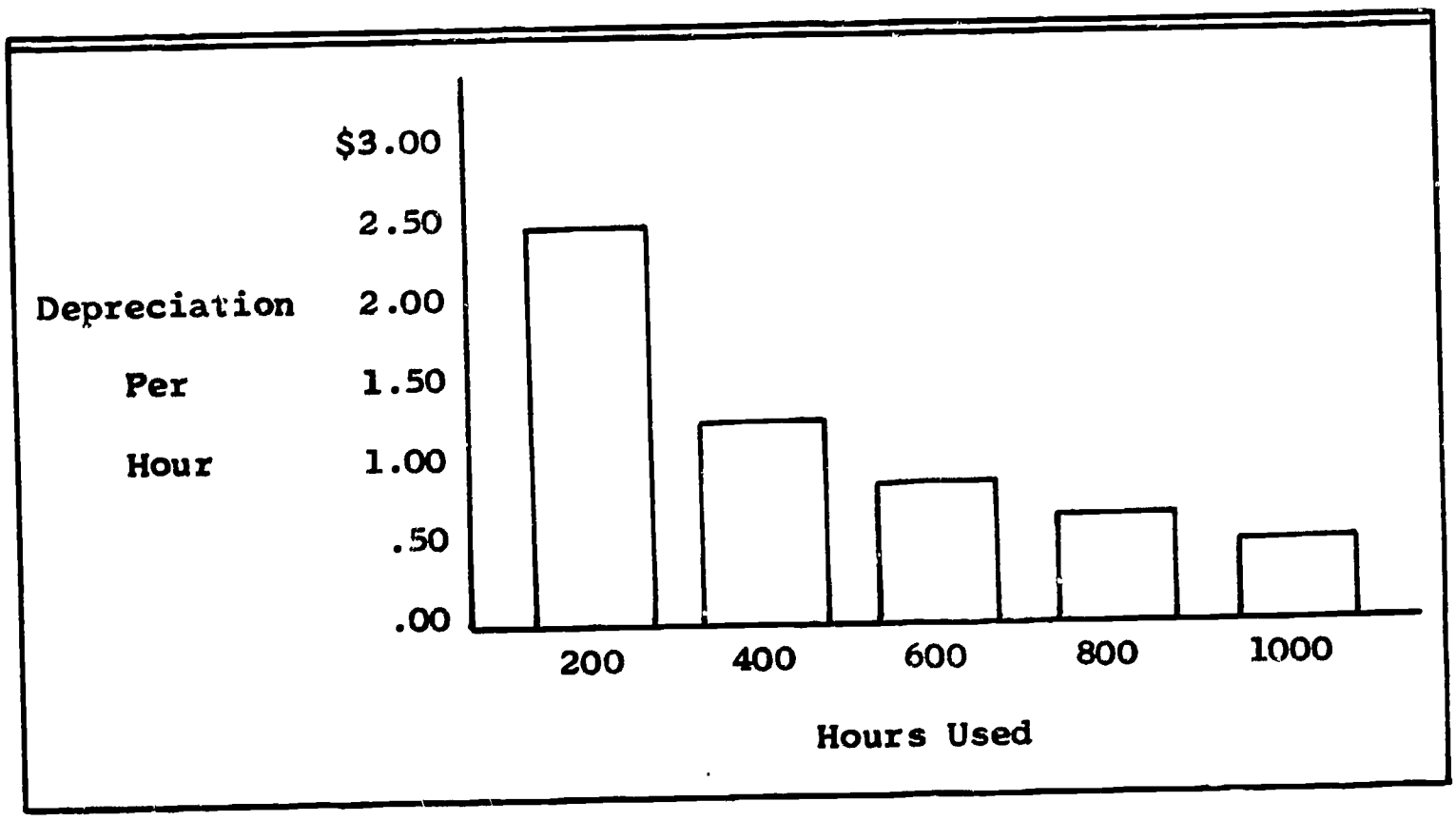
/Note to Teacher:/ Assume the same situation as Example #2 except the student wants to determine the depreciation cost per hour if his annual use is 200, 400, 600, or 800 hours. Assign students to work each problem by dividing the $500 annual depreciation by the number of hours the tractor was used. Then make a graph on the board having the bars equal the depreciation cost for each hour operated. Chart I might serve as an example.

Key Questions to Assist Students in Reaching Conclusions:

1. How much does the depreciation per hour cost when you use the tractor 200 hours? How much when you use the tractor 800 hours?
2. Why is there a difference?
3. Would this be true on other farm power and equipment?

CHART 1

DEPRECIATION COST PER HOUR OF TRACTOR USE



4. Would other fixed costs such as interest, taxes, and insurance follow this pattern? Why? (Yes, because they are also fixed costs.)

5. Does the total annual depreciation change? (No)

6. Why does the depreciation cost per hour decrease as the tractor is used more hours?

Conclusions to be Drawn From Example #3:

1. The total depreciation per year remains the same regardless of the number of hours used.

2. The depreciation per tractor hour declines by spreading the annual depreciation charge over more hours of use.

Example #4. (Land Cost Per Bushel of Corn)

This example will show that fixed costs per unit of production vary with total units of output (production).

Assume that you are cash renting ten acres of corn ground for $15 per acre.

Leading Questions:

1. Do any of you rent land?

2. What is meant by cash renting?

3. What would you have to pay to rent corn land per acre?

4. Is the rent of land a fixed or variable cost? (fixed)

5. What would be the total amount of cash rent?

6. Would the total cash rent vary with the amount of production?

7. Would the cash rent cost per bushel vary with the amount of production?

/Note to Teacher:/ Develop Table 1 on the board or on a transparency. Have the students calculate rent per bushel and record in the last column.

Key Questions to Assist Students in Reaching Conclusions:

1. As the production increased, what happened to the cost of the cash rent per acre? (same) Total cash rent? (same)

2. As the production increased, what happened to the cost of the cash rent per bushel? Why? (It decreased because the fixed cost per acre becomes variable per bushel.)

Conclusions to be Drawn From Example #4:

1. The fixed cost per acre remains the same regardless of production.

2. The fixed cost per bushel declines, or becomes variable, by spreading the fixed cost over more bushels.

Example #5. (Variable Cost of Fertilizer on Corn)

Assume that you rented four, ten-acre plots to grow corn, and plan on applying $20 worth of fertilizer per acre on each plot. Develop a table (See Table 2) showing the fertilizer cost per bushel if you produced 60 bushel of corn per acre on plot 1, 90 bu. on plot 2, 120 bu. on plot 3, and 150 bu. on plot 4.

Leading Question:

1. Do we apply fertilizer per acre or per bushel?

Key Questions to Assist Students in Reaching Conclusions:

1. Did the costs of fertilizer per acre change? (No)

2. What happened to the cost of fertilizer per bushel as the yield received increased? Why? (Cost decreased because there were more bushels to share the cost.)

TABLE 1

CASH RENT COSTS

Bu. of Corn Produced/Acre	Cash Rent Per Acre	(for teacher only) Cash Rent Per Bu.
60	$15	$.25
90	15	.167
120	15	.125
150	15	.10

TABLE 2

FERTILIZER COST PER BUSHEL

Plot Number	Bushel of Corn Produced Per Acre	Cost of Fertilizer Per Acre	(for teacher only) Cost of Fertilizer Per Bushel
1	60	$20	$.333
2	90	20	.222
3	120	20	.167
4	150	20	.133

TABLE 3

EFFECTS OF FIXED AND VARIABLE COSTS

# N. Applied Per Acre @ 10¢/#	Yield/A. Bu. @ $1/bu.	Rent Per Acre	Rent Per Bushel	(for teacher only) N. Cost Per Acre	N. Cost Per Bu.	Total Costs Per Bu.
0	30	$15	$.50	$-0-	$-0-	$.50
40	60	15	.25	4	.067	.317
80	90	15	.167	8	.089	.256
120	120	15	.125	12	.10	.225
160	150	15	.10	16	.107	.207
200	160	15	.094	20	.125	.219

3. Is the cost of fertilizer per bushel fixed or variable cost? (Variable)

Conclusions to be Drawn From Example #5:

1. The variable cost of fertilizer per bushel will vary with the yield received.

Example #6. (Fixed and Variable Costs in Producing Corn)

Assume that you are now renting 60 acres of corn ground at $15 per acre. Nitrogen can be applied in amounts from 0 to 200 lb. Work out a table (See Table 3) using the different amounts of nitrogen fertilizer and yields per acre. Base your calculations on one acre.

Leading Questions:

1. What can one expect by applying different amounts of fertilizer to corn?

2. If we can expect an increase in yield, how will this affect the fixed costs per bushel? Per acre?

Key Questions to Assist Students in Reaching Conclusions:

1. Was the yield at 40 lb. of nitrogen the same as at 120 lb.? (No, the 120 lb. of nitrogen gave 60 bushels more.)

2. Did the fertilizer cost per bushel increase as more nitrogen was added?

3. Would it always pay to add more nitrogen? Why? (No. Principle of diminishing returns.)

4. Does the rent cost per bushel decline as the yield increases? Why? (Yes, because the cost is spread over more units.)

5. Are fixed and variable costs affected the same when production is increased? (No)

6. Did the total cost per bushel continue to go down as yield increased? Why? (No. Variable cost increased more than the fixed costs decreased.)

Conclusions to be Drawn From Example #6:

1. A variable cost can be increased as long as the cost is covered by the additional returns. (MC = MR)

2. A fixed cost will be constant in total but will decline per unit of product (bushels) as yield increases.

3. An optimum level of production is reached when the balance between the fixed and variable costs gives maximum profit.

/Note to Teacher:/ Students should realize that there are some fixed costs in capital investments (interest). This charge can be figured for the year and should be considered as a cost of production. This is an opportunity to consider the comparison of owning or leasing machinery.

V. ASSOCIATION OF EXAMPLES:

In order to show the association and/or relationship of the conclusions derived from the previous examples to the principle of fixed-variable costs, the following activities are suggested.

Teacher Activity

1. Again, list all conclusions derived from previous examples illustrated in this unit and show their association and relationship. The teacher should attempt to have students identify the commonalities derived from the various examples in order to arrive at basic concepts regarding this principle.

2. The following questions could be used for class discussion:

   a. How are fixed and variable costs different?

b. Would the fixed costs of a building change from year to year?

c. How does the factor of time affect fixed and variable costs?

d. Does a fixed cost ever become variable or vice versa?

VI. ARRIVING AT THE PRINCIPLE:

Now that the students understand how the previous examples are associated, they should be ready to develop a statement of the principle.

Teacher Activity

1. Review with the students new terminology evolving from the unit.

2. Have the students prepare an example of the principle and a written statement of their impression of it.

3. With the students, develop a working definition of this principle by combining the basic commonalities discussed from the association of the examples presented in the unit.

4. A specific definition of the fixed-variable principle is: "The cost per unit of production can be decreased by spreading fixed costs over more units of production. Therefore, the farm manager should continue using more resources, if capital is available, to increase production as long as variable costs are covered by additional returns."

VII. STUDENT ACTIVITIES:

By applying the principle to realistic situations, the students will develop a better understanding of its meaning.

The following are suggested student activities the instructor may wish to use:

Activity #1. Have the students calculate the fixed and variable

costs involved in owning various types of equipment. The following example for a combine may be used as a guide.

Example: A twelve foot, 70 horsepower, gasoline-driven, self-propelled combine costing $7,000.[1]

Step 1. Determining the Fixed Costs.

A. Annual Depreciation:

$$\frac{\text{Purchase price } \$7{,}000^*}{\text{Expected life } 10 \text{ years}} = \text{Annual depreciation} \qquad \$\ 700$$

(*$0.00 salvage value.)

B. Annual Interest:

$$\text{Interest rate } 8\% \text{ short term} \times \text{Purchase Price } \frac{\$7{,}000}{2} = \text{Annual interest on capital invested}$$

$ 280

C. Annual Personal Property Tax: (This is the average figure. Check the local rates when figuring your situation.)

Purchase price $7,000 x 30% = $2,100 assessed value.

Assessed value $2,100 x 3% (30 mils = 3%) = Annual property tax.

$ 63

D. Annual Insurance:

Purchase price $\frac{\$7{,}000}{2}$ = $3,500. Average value

Average value $\frac{\$3{,}500}{100}$ x $.40 (Rate per $100) = Annual Insurance

$ 14

Total Fixed Costs $1,057

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[1]Combines and Combining, Vocational Agriculture Service, The Ohio State University.

Step 2. Determining Variable Costs Per Acre.

A. Fuel Costs Per Acre:

Maximum Drawbar Horsepower 70 x Amount of Fuel .07 gal. gasoline (.05 gal. diesel) x Price of Fuel $ .20

x Hours Used Per Acre .42 . . . Fuel Cost Per Acre (Gasoline) = $ .41

B. Lubrication Costs Per Acre:

Fuel cost $.41 x 13% = Lubrication cost per acre $ .05

C. Repair Costs Per Acre:

Purchase price $7,000 x 4% = $280

$280 ÷ 280 A. . . . . = $1.00

(The number of acres will vary, while the average here is 280.)

D. Operators Labor Per Acre:

Hours per acre .42 x 1 acre x $1.50 . . . . . = $ .63

Total Variable Costs Per Acre $2.10

Activity #2. Charts may be developed to show fixed and variable costs per acre for each of the pieces of equipment in Activity #1.

Activity #3. Students may be assigned charts to complete which show fixed and variable costs per unit. Charts A and B are examples.

CHART A

EQUIPMENT COSTS PER BUSHEL

Bushels of Corn Per Acre	Tractor and Machinery Costs Per Acre	(for student completion) Tractor and Machinery Costs Per Bushel
0	$18	---
60	18	.30
80	18	.225
100	18	.18
120	18	.15

CHART B

FIXED AND VARIABLE COSTS PER BUSHEL

Bushel Corn/A	Variable Costs/A	Fixed Costs/A	(for student completion) Fixed Costs/bu.	Variable Costs/bu.	Total Cost/bu.
60	$20	$18	$.30	$.33	$.63
80	20	18	.23	.25	.48
100	20	18	.18	.20	.38
120	20	18	.15	.17	.32

STUDENT WORK SHEET

FIGURING DEPRECIATION AS A FIXED COST

What is depreciation?

Why is depreciation on a car a fixed cost?

How to figure yearly depreciation on a car:

You must know:

1. The cost price of the new car.
2. How many years you expect to keep the car.
3. What you can expect to get for it as a used car. (salvage value)

The formula for yearly depreciation is:

Cost (new)	minus	salvage value (trade-in)	divided by	years of life (years of use)

Examples:

What will be the yearly depreciation of a new car that you buy for $3400. You expect to drive it for 3 years and receive a trade-in value of $1000.

What is the yearly depreciation on a new tractor that you have purchased for $6000. You expect to use this tractor for 8 years and receive a trade-in value of $400.

What will be the yearly depreciation on a dairy cow that you have purchased for $500. You expect to milk her for 5 years and then sell her for beef at $100.

DEPRECIATION IS IMPORTANT SINCE IT IS AN ALLOWABLE DEDUCTION FROM YOUR INCOME TAX.

STUDENT WORK SHEET

DETERMINING COST PER MILE TO OPERATE A CAR

Many sales people who use their own car for business purposes are paid a mileage allowance.

What would you consider to be a fair rate per mile for a car allowance? _____

A salesman is reimbursed 8¢ per mile for the use of his car. Does this allowance pay for the costs of operating his car? Consider the following situation:

Fixed Costs:

Depreciation: $3000 car that he will keep for 4 years and then sell for $600.

_____ (cost) minus _____ (trade-in) divided by _____ (years of use) = _____

Interest: This man borrowed $2000 to buy his car. The bank rate was $5 per $100 per year.

_____ (Number of $100 units) times $5 = _____

Insurance: The insurance premium is $78 for 6 months.

_____ (six month's premium) times 2 = _____

License: State license charge is $20 per year = _____

Total Fixed Costs For The Year = _____

Variable Costs:

Gasoline: 1250 gallons @ 32¢ per gallon = _____

Oil and grease: $5 per service--one service per month = _____

Repairs and maintenance @ $20 per month = _____

Total Variable Costs For The Year = _____

TOTAL Fixed And Variable Costs For The Year = _____

(Continued)

STUDENT WORK SHEET--(Continued)

Determining Cost Per Mile To Operate A Car:

The car was driven 20,000 miles during the year. What was the actual cost of operating per mile?

_____	divided by	_____	equals	_____
total costs		total miles		cost per mile

STUDENT WORK SHEET

FIGURING EFFICIENCY FACTORS ON CORN PRODUCTION

	Farmer A	Farmer B
Number of acres	5	15
Total yield--bu. (56 lbs./bu.) of dry shelled corn	625	1,425
Selling price--per bushel . .	$1	$1
Charge for land per acre . . .	$20	$20
Seed corn used	1 bu. @ $15	3 bu. @ $12
Broadcast fertilizer	200# 12-12-12 @ $75 per ton	-----
Fertilizer in planter	200# 6-24-12 @ $72 per ton	350# 5-20-20 @ $68 per ton
Pounds of nitrogen (actual N) per acre @ 11¢ per pound . .	100#	80#
Pounds of atrazine per acre @ $2.50 per #	2#	1#
Total hours machinery use in plowing, planting, cultivating, etc. @ $2 per hour . .	15 hours	40 hours
Picking @ $6 per acre	$30	$90

Figure Efficiency Factors

Yield per acre	_____	_____
Total receipts from corn per acre	_____	_____
Fertilizer cost per acre . .	_____	_____
Seed cost per acre	_____	_____
Chemical cost per acre . . .	_____	_____
Machinery cost per acre . .	_____	_____
Picking charge per acre . .	_____	_____
Land cost per acre	_____	_____
Total cost of production per acre	_____	_____
Cost of production per bushel.	_____	_____
Net income per acre	_____	_____
Net income per bushel	_____	_____

STUDENT WORK SHEET

FIGURING FIXED-VARIABLE COSTS

1. Use the following table to answer questions a and b below:

CASH RENT COSTS FOR CORN

Bu. of Corn Produced/Acre	Cash Rent Per Acre	Cash Rent Per Bushel
60	$15	_____
90	15	_____
120	15	_____
150	15	_____

a. As the production increased, what happened to the cost of the cash rent per acre? _____ Total cash rent? _____

b. As the production increased, what happened to the cost of the cash rent per bushel? _____ Why?

2. Assume that you rented four, ten-acre plots to grow corn, and plan on applying $20 worth of fertilizer per acre on each plot. Complete the following table showing the fertilizer cost per bushel if you produce 50 bu. corn on plot 1, 80 bu. on plot 2, 110 bu. on plot 3, and 140 bu. on plot 4.

VARIABLE COST OF FERTILIZER ON CORN

Plot Number	Bushel Corn Per Acre	Cost of Fertilizer/Acre	Cost of Fertilizer/Bushel
1	50	$20	$_____
2	80	20	_____
3	110	20	_____
4	140	20	_____

a. Did the costs of fertilizer per acre change? _____

b. What happened to the cost of fertilizer per bushel as the yield received increased? _____ Why?

c. Is the cost of fertilizer per bushel a fixed or variable cost? _____

SAMPLE QUIZ ON DEPRECIATION--A FIXED COST

One year depreciation:

How much depreciation will there be on a combine for one year that was purchased for $2000, has a salvage value of $400, and will be used for 8 years?

One-half year depreciation:

How much depreciation will be allowed for 6 months on a cow that was purchased for $4[illegible], has a $100 salvage (beef) value, and will have a useful life of 5 years?

5 months depreciation:

How much depreciation can be taken for the remainder of the year on a corn picker that was purchased for $800, has a salvage value of $80, and will be used for 12 years? This machine was purchased July 20.

3 months depreciation:

How much depreciation can be taken for one-fourth year on five sows that were purchased at $500, have a salvage (meat) value of $100, and have a 4 year useful life?

SAMPLE QUIZ ON FIXED AND VARIABLE COSTS

Complete Tables I and II below.

1.

TABLE I

EQUIPMENT COSTS PER BUSHEL

Bushels of Corn Per Acre	Tractor and Machinery Costs Per Acre	Tractor and Machinery Costs Per Bushel
0	$18	_____
60	18	_____
80	18	_____
100	18	_____
120	18	_____

2.

TABLE II

FIXED AND VARIABLE COSTS PER BUSHEL

Bushel Corn/A	Variable Costs/A	Fixed Costs/A	Variable Costs/bu.	Fixed Costs/bu.	Total Cost/bu.
60	$20	$18	_____	.30	_____
80	20	18	.25	_____	_____
100	20	18	_____	_____	_____
120	20	18	_____	_____	.32

(Continued)

SAMPLE QUIZ ON FIXED AND VARIABLE COSTS--(Continued)

3. Assume that you are now renting 60 acres of corn ground at $15 per acre. Nitrogen can be applied in amounts from 0 to 200 lb. Base your calculations on one acre. Use the following table to answer the questions below.

FIXED AND VARIABLE COSTS IN PRODUCING CORN

#N Applied Per Acre @ 10¢/#	Yield/A. Bu. @ $1/bu.	Rent Per Acre	Rent Per Bushel	N Cost Per Acre	N Cost Per Bu.	Total Costs Per Bu.
0	30	$15	_____	_____	_____	_____
40	60	15	_____	_____	_____	_____
80	90	15	_____	_____	_____	_____
120	120	15	_____	_____	_____	_____
160	150	15	_____	_____	_____	_____
200	160	15	_____	_____	_____	_____

a. Was the yield at 40 lb. of nitrogen the same as at 120 lb? _____

b. Did the fertilizer cost per bushel increase as more nitrogen was added? _____

c. Would it always pay to add more nitrogen? _____ Why?

d. Does the rent cost per bushel decline as the yield increases? ___ Why?

e. Are fixed and variable costs affected the same when production is increased?

VIII. SOURCES - REFERENCES

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SUBSTITUTION

Suggested Teaching Time: 1 week

Terms Used In This Unit:

Budget: An estimate of costs and returns.

Constant Substitution: When one resource substitutes for another at the same rate for each additional unit of input. (Can be physical or financial.)

Gross Returns: Income before expenses are deducted.

Net Return: Income after all costs have been paid.

Resource: Available means; wealth in money, property, products, etc.

Substitute: To replace or take the place of.

Substitution Ratio: The number of units of "replaced" resource divided by the number of units of "added" resource.

I. TEACHING UNIT: PRINCIPLE OF SUBSTITUTION

II. UNIT OBJECTIVES:

A. To discover that one input may be substituted for another at either a constant or diminishing rate to produce a given output.

B. To identify that the value of the input replaced must be greater than the value of the input added to reduce production cost.

C. To discover that the factors of production (land, labor, capital, and management) may be substituted for each other.

D. To discover that the principle of diminishing returns applies to inputs that substitute at diminishing rates.

III. INTRODUCTION:

Technique for Introducing Unit:

The teacher should develop an example with the students. The example should be simplified and involve common student activities such as the example that follows:

(Substituting Diesel Power for Gasoline)

A farmer has been doing his field work with gasoline-powered tractors. He has been using the tractors for 100 ten-hour days annually with the consumption of 20 gallons of gasoline per day. The particular diesel tractors that he plans to substitute in the future will consume only 80% as many gallons of fuel as compared to the gasoline-powered tractors. This is due to diesel power efficiency.

Leading Questions:

1. How many of you have diesel powered tractors at home?

2. How many have both types of tractors?

3. How does the efficiency in this example compare to your tractors or ones you have heard about?

4. Which type of tractor has the higher initial cost? (Diesel)

5. Which type of fuel is the most costly? (Gasoline)

6. Which tractor requires the greatest amount of maintenance? (This varies with the extent of use and type of maintenance.)

/Note to Teacher:/ Place Table 1 on the chalk board.

TABLE 1

AMOUNTS OF DIESEL FUEL REQUIRED TO REPLACE GASOLINE FOR FARM TRACTOR OPERATION

Days of Work	Gasoline Used (in Gal.)	Diesel Fuel Used (in Gal.) to Replace Gasoline
25	500	400
50	1000	800
75	1500	1200
100	2000	1600

/Note to Teacher:/ Idea to be brought out by this example: that items of input can be substituted.

Conclusions to be Drawn From This Example:

1. By the substitution of some items of input (diesel fuel) for other items (gasoline), the cost of operation or the cost of production may be reduced.

2. Some substitutions may not be practical due to other considerations. Original investment, repairs, depreciation, etc. need to be considered. In the above example we assume fuel cost to be the primary consideration.

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

Through additional discussion and actual agricultural examples, the teacher will assist the students in discovering the principle of substitution and its function. These examples and the discussion should be made as applicable to the community and the students' situations as possible.

Example #1. (Feeding Hogs)

A boy has just purchased a lot of feeder pigs. Through the use of research material he estimates the amount of feed required to produce a gain of 100 lb. He can feed a ration of either shelled corn alone or one with shelled corn and varying amounts of 40% commercial hog supplement.

Leading Questions:

1. How many of you feed commercial hog supplement?
2. Are all hog supplements the same? (No. Some contain more protein, vitamins, etc.)
3. Do hogs grow more rapidly when fed supplement? (Yes)
4. What does hog supplement contain? (Tankage, meat scraps, soybean meal, etc.)
5. Can a farmer feed his hogs too much supplement? (Yes)
6. What happens when we over-feed supplement? (Costs go up first. When large amounts are fed they can cause swine health problems.)

/Note to Teacher:/ Place the first two columns of Table 2 on the chalk board. Develop the last column with the aid of the class.

TABLE 2

AMOUNTS OF SHELLED CORN AND 40% HOG SUPPLEMENT REQUIRED TO PRODUCE 100 POUNDS OF PORK

Combinations That Will Produce 100 Lbs. of Pork		Pounds of Corn Replaced By Each Additional 10 Lbs. of Supplement
Shelled Corn	Supplement	
500	0	--
380	10	120
300	20	80
245	30	55
210	40	35
180	50	30
165	60	15
155	70	10
146	80	9

/Note to Teacher:/ Idea to be brought out by this situation is: diminishing rate of physical substitution.

Key Questions to Assist Students in Reaching Conclusions:

1. What happened when more supplement was fed? (It decreased the amount of corn needed.)

2. Did each additional unit of 10 lb. supplement replace the same amount of shelled corn as the previous unit? (No. It diminished and finally replaced less pounds of corn than its own weight.)

3. Which 10 lb. of supplement replaced the greatest amount of shelled corn? (The first 10 lb.)

4. At what point did an additional pound of supplement replace less than a pound of corn? (The rate of 80 lb.)

Example #2. (Weed Control Favoring Atrazine)

A student has a 10 acre corn project. He can control the weeds in this field with two cultivations at $1.75 per acre per cultivation; or, he may substitute a herbicide (atrazine) for weed control at a cost of $2 per pound and a rate of one pound per acre plus 50¢ per acre for application.

Leading Questions:

1. What is atrazine? (A herbicide.)

2. How many of you use atrazine on your home farm?

3. What is the cost of herbicide and application for one acre? (Approximately $2.50)

4. Will the corn yield be the same by using either method? (Usually, if both procedures are properly executed.)

/Note to Teacher:/ Make the following calculations on the chalk board with the assistance of students.

Cultivation Costs

10 acres x $1.75 = $17.50
Twice for season 2 x $17.50 = $35
Total for cultivation = $35

Herbicide Weed Control Costs

Herbicide 10 acres x $2 = $20
Application 10 acres x 50¢ = 5
Total for herbicide = $25

Cultivation Costs	$35
Herbicide Costs	- 25
Net Savings for Herbicide Weed Control	$10

/Note to Teacher:/ Idea to be brought out by this example is: marginal costs must equal marginal returns when variable inputs are to be substituted.

Key Questions to Assist Students in Reaching Conclusions:

1. Which method of weed control involves the least cost and maximizes profits? (atrazine)

2. Is cost the only consideration in determining the method of weed control? (No. The crops that follow and equipment available may be others.)

3. Is it important that an agricultural operation make a net profit? (Yes, if it is to continue in operation.)

Conclusions to be Drawn from Example #2:

1. Both chemical and mechanical methods can be used to control weeds.

2. When all other considerations are equal, the least costly procedure of production should be used to maximize profits.

3. When substitution involves only one unit of each input (one added unit substitutes for one original unit), the only comparison that need be made is between the cost of the original practice and the one being substituted.

4. In order for a substitution to be profitable, it must result in the greatest net return.

Example #3. (Weed Control Favoring Cultivation)

By slightly altering the facts in Example #2, the student can be shown that under some situations the substitution of atrazine for cultivation can actually increase costs and reduce net profits.

In this example the soil is heavy and two pounds of atrazine will be needed to give satisfactory weed control.

Leading Questions:

1. How could soil type alter the situation? (Greater costs for the herbicide.)
2. What could happen to the cost of mechanical control? (The cost for mechanical control would probably remain the same.)

/Note to Teacher:/ Recalculate with the students the cost of weed control under these heavy soil conditions.

Cultivation Costs		Herbicide Weed Control Costs	
10 acres x $1.75 = $17.50		Herbicide 10 acres x $4	= $40
Twice for season 2 x $17.50 = $35		(2 lb. per acre, $2 per lb.)	
Total for cultivation	= $35	Application 10 acres x 50¢	= 5
		Total for herbicide	= $45

Herbicide Control Costs	$45
Cultivation Costs	35
Net Loss for Herbicide Weed Control over Cultivation	$10

/Note to Teacher:/ Idea to be brought out by this example is: unfavorable substitution.

Key Questions to Assist Students in Reaching Conclusions:

1. Is herbicide weed control always the most profitable? (No)
2. Is the substitution of one resource for another always profitable? (No)

Conclusions to be Drawn From Example #3:

1. Not all substitutions (atrazine for cultivation) result in maximizing profits.

2. A substitution may be profitable under one set of circumstances (light soil) and unprofitable in another situation (heavy soil).

Example #4. (Substituting Factors of Production for Land)

This example shows the student a more complicated application of the principle of substitution.

A farmer has been raising corn on 20 acres of his own land and 10 acres of rented land. He produces 90 bushels per acre at home and 70 bushels per acre on the rented land.

He estimates he could boost his yields from 90 bushels to 125 bushels on his own land by using more fertilizer and herbicides. In applying the principle of substitution he calculates the relative cost and returns from a high fertility program compared to his customary system. (See calculations for Example #4.)

Leading Questions:

1. Are land and fertilizer the same thing?

2. What are two ways of raising more corn? (Plant more acres or increase yield per acre.)

3. Which way will make the most money? (It depends on costs.)

/Note to Teacher:/ To make this more dramatic, a student's situation could be used in place of this problem, or just replace the farmer with a student's name. The student and teacher then calculate the net return decrease or increase for the substitution. In this case again the substitution would result in a greater net return.

Calculations for Example #4

A. Customary System of Corn Production

Returns:		Costs:	
Yield of 2500 bushels		Rent for 10 acres at $20/acre	$ 200
Value $1.10 per bushel or	$2750	Value of land owned--20 acres at $25/acre	500
Total gross return	$2750	Seed for 30 acres (6 bu. at $15)	90
		Fertilizer 200 lb. 5-10-10/acre 3 Ton at $50/ton	150
		Machinery cost per acre--$15	450
Net Returns:		Value of Labor 6 hrs. per acre	
Gross Returns	$2750	$1.50 per hr. 6 x 30 x $1.50	270
Costs	1660	Total Costs	$1660
Net Returns	$1090	(Plus other fixed costs of production)	

B. Higher Fertility and Better Weed Control System of Corn Production

Gross Returns:		Costs:	
Yield of 2500 bushels		*Value of 20 acres owned land at $25/acre	$ 500
Value $1.10/bushel	$2750	*Seed for 20 acres, 4 bu. at $15	60
Total gross return	$2750	*Fertilizer 200 lb. 5-10-10/acre 2 Ton at $50/ton	100
		**Amonium Nitrate (Plowed down) 300 lb. - 33½% N 3 T. at $80/ton spread	240
		*Machinery cost per acre $15 x 20	300
		**Weed control ½ lb. 2,4-D/acre, $1.50/acre applied	30
Net Returns:		*Value of labor 6 hrs./acre at	
Gross Returns	$2750	$1.50/hr. 6 x 20 x $1.50	180
Costs	1410	Total Costs	$1410
Net Returns	$1340	(Plus other fixed costs of production)	

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*Items of total cost reduced by smaller acreage.

**Items of cost added or substituted for land.

Fertility and Weed Control System	$1,340
Customary System	1,090
Increased return for substitution	$ 250

Ideas to be brought cut in Example 4 are: (a) one factor of production can substitute for another factor; and (b) more than one input can substitute for a single input. From this example we see that the farmer, by not farming 10 acres of less productive rented land, can avoid rent costs. But, in order to secure the same total yield, he must add other costs of fertilizer and weed control as a substitute for the land not rented.

Key Questions to Assist Students in Reaching Conclusions:

1. What resources were substituted for land? (Capital for fertilizer and herbicides.)
2. Was it more profitable for the farmer to do a better job on his own land in this example? (Yes.)
3. What could be done with the money saved by not paying rent? (intensify his own crop production by buying more supplies.)
4. What could be done with the labor and management saved by not farming rented acres? (Do a better job at home.)

Conclusions to be Drawn From Example #4:

1. One factor of production may be substituted for another.
2. More than one input may be substituted for a single resource to arrive at the same output.

Example #5. (Diminishing Returns from Substitution)

The above problem could also be recalculated with an additional application of $150 worth of fertilizer for the 20 acres. This could be estimated to result in a 5 bushel yield increase per acre.

(It must be assumed that any greater expenditure for weed control would not result in increased yield.)

Returns	Costs
5 bushel x 20 acres x $1.10 = $110	Fertilizer - $150

Costs	$150
Returns	110
Net loss for Fertilizer	$ 40

/Note to Teacher:/ It should be pointed out to the student that there is a limitation to the extent of making a substitution. A relationship can also be made with the principle of diminishing economic returns.

Key Questions to Assist Students in Reaching Conclusions:

1. What happened when more fertilizer was substituted? (The returns diminished.)
2. Was it profitable to substitute fertilizer for land at this level? (No)
3. What other principle is at work here? (Principle of Diminishing Returns.)

Conclusions to be Drawn From Example #5:

1. There is a limit to the economic level of substitution.
2. The optimum substitution level is determined by the Principle of Diminishing Returns.

V. ASSOCIATION OF EXAMPLES:

In the previous examples students should begin to note that there are similarities between the examples. The student will also

observe some differences. But, most of all, he should begin to see that the same principle is involved in each example.

Teacher Activity

1. The student should be assisted in discovering that the value of the resource replaced must be greater than the value of the resource added if the substitution is to be profitable. He should note by this time that not all substitutions will maximize profits and that even when a substitution does increase net returns, there may be a point of diminishing returns after which further substitution is not desirable.

2. The teacher should be alerting the student of the fact that other profit-maximizing principles may be concurrently involved in a given situation along with the principle of substitution.

3. From the conclusions drawn from the previous examples and further study, the teacher and students may cooperatively develop the following list, or one similar, which should aid in associating the examples of the principle under study.

   a. The agricultural manager has numerous opportunities to substitute one resource for another to arrive at the same output.

   b. Some resources may be completely substituted for another to maximize profits while other resources can only be partially substituted for another.

   c. There may be much similarity or considerable difference in the type of resources that can be used to replace one with another.

   d. Resources may substitute for one another at a diminishing rate when each added unit substitutes for less than the previous unit.

   e. Some resources may continue to substitute for others at a constant rate.

   f. A substitution may be profitable or unprofitable--depending upon the particular situation.

   g. The value of the resource replaced must be greater than the value of the resource added to keep production costs at a minimum.

h. More than one "added" input may be substituted for a single resource.

i. Some substitution may replace, as well as increase, the output (yield) over the original resource.

j. The optimum substitution level is determined by the principle of diminishing economic returns.

VI. ARRIVING AT THE PRINCIPLE:

After the previous discussion, the students should be aware of the profit-maximizing principle of substitution. Their understanding of the principle may still not be clear, but they should know that the substitution of inputs has an important role in the decision-making process used by farms and other agricultural business managers.

Teacher Activity

1. Have each student independently develop a definition for the principle of substitution.

2. Some or all of these may be read aloud and a cooperative definition can be developed on the chalk board by the teacher and students. The wording should be in the language of the students.

3. A guide (do not copy on the board) to the teacher for developing this definition is: "When two or more types of resource inputs can be used to produce a given amount of output, the value of the resource replaced or displaced by another resource should be greater than the value of the resource added if the farm manager is to secure maximum profits."

VII. STUDENT ACTIVITIES:

The following or similar examples should be worked through first by the students in a supervised study period. Students should complete a partial budget for each problem. Following this period, the teacher and class should work out the examples on the chalk board for greater understanding.

Problem #1. A farmer is feeding a ration of "corn alone" to his market hogs. It will require 10 bushels of corn at $1.25 per bushel to produce 100 lb. of pork. By substituting 40 lb. of commercial supplement at $6 per cwt. for part of the corn it will only require 5 bushels. What is the savings per 100 lb. of pork produced?

A. 10 bushels corn @ $1.25 = $12.50

B. 5 bushels corn @ $1.25 = $6.25
40 lb. supplement @ $6/cwt. = 2.40
8.65

Increased profits per 100 lb. pork $ 3.85

Problem #2. A grain elevator has been using clerical help to write checks and record sales and purchases of grain annually. To complete this operation it has required two clerks working 4000 hours. The hourly rate for these persons is $2. An IBM unit would reduce the hours required to 2000 per year. (Thus eliminating one clerk.) The rental service of the machine is $2250 per year and the special supplies required will amount to $700. What will be the annual net profit from the installation of the IBM equipment? In other words, what is the value of this substitution?

Clerical Method		IBM Equipment Substitution	
Labor 4000 hrs. at $2 =	$8000	Labor 2000 hrs. at $2 =	$4000
		Rental of Unit	2250
Total Cost	$8000	Special Supplies	700
		Total Cost	$6950

Clerical Method	$8000
IBM Method	6950
Net Savings	$1050

Problem #3. Have students develop partial budgets for problems #1 and #2.

Problem #4. Each student should select an actual situation to which the principle of substitution may be applied. He should then prepare budgets for the costs and returns before and after substitution. The best of these examples may be placed on the board and discussed with the class by the students themselves. Similarities and differences in the way substitutions apply should be pointed out by the teacher through discussion and questions.

STUDENT WORK SHEET

SUBSTITUTING DIESEL FUEL FOR GASOLINE

In recent years many trucking industries and farm operators have switched from gasoline to diesel fueled engines because of the economy of operation. Although the initial cost of diesel engines is higher, the efficiency of operation more than offsets this investment.

Compare the yearly operating costs of a diesel tractor with a gasoline tractor:

Each tractor is used the equivalent of 110, ten-hour days per year.

Fuel consumption is 20 gallons per day or 2200 gallons per year for the gasoline tractor. The diesel tractor uses 80% of this amount.

The cost of gasoline is 30¢ per gallon. Diesel fuel is 20¢ per gallon.

The initial cost is $5000 for the diesel tractor and $4000 for the gas tractor.

Both tractors will have a life of 10 years.

The repairs and maintenance are estimated to be $200 per year for each unit.

YEARLY OPERATING COSTS

Item	Gasoline Tractor	Diesel Tractor
Fuel Cost	_____	_____
Depreciation	_____	_____
Repairs and Maintenance	_____	_____
Yearly Cost	_____	_____
Per Hour Cost	_____	_____

STUDENT WORK SHEET

SUBSTITUTING SUPPLEMENT FOR CORN IN FEEDING HOGS

By substituting supplement for corn in a hog ration, 100 pounds of pork can be produced cheaper than when feeding all corn.

What is the best substitution rate when using the following combinations:

Shelled corn valued at $2 per 100 pounds

Supplement valued at $6 per 100 pounds.

Any of the following combinations will produce 100 pounds of pork. What is the cost in each case?

Pounds of Shelled Corn	Pounds of Supplement	Cost to Produce 100 Pounds of Pork
500	0	_____
380	10	_____
300	20	_____
250	30	_____
210	50	_____
180	70	_____
150	90	_____

What is the most economical rate of corn and supplement to produce 100 pounds of pork? _____corn, and _____supplement.

Note: Even at the highest rate of supplement it is cheaper to produce 100 pounds of pork than when feeding all corn.

STUDENT WORK SHEET

SUBSTITUTING GRAINS FOR FATTENING BEEF CATTLE

Corn is the best grain for fattening animals. However, at times it is less expensive to use a substitute grain. Consider the following situation when fattening beef cattle:

Wheat has the same feeding value as corn.

Barely has 90% of the feeding value of corn.

Oats has 85% of the feeding value of corn.

When corn is valued at $2.40 per cwt., how much are wheat, barley, and oats worth per cwt. at the above feed values?

Wheat $_____ Barley $_____ Oats $_____

Grains are often sold by the bushel rather than by the hundred.

Corn weighs 56# per bushel. Wheat weighs 60# per bushel.

Oats weighs 32# per ton. Barley weighs 48# per bushel.

When corn is selling for $1.12 per bushel, what is the per bushel value of wheat, barley, and oats for feeding steers. (Use the percentages above.)

Wheat $_____ Barley $_____ Oats $_____

When a given grain is selling for a high price it may be profitable to substitute another grain for it when feeding animals.

STUDENT WORK SHEET

STUDYING EXPENSIVE HARVESTING MACHINERY VS. HAND LABOR

In the potato, sugar beet, cotton, and vegetable fields expensive harvesting machinery has replaced much of the hand labor in harvesting. These machines are generally very expensive. Therefore, the manager of the operation must decide if this is a good investment. (Should he continue to use hand labor or should he SUBSTITUTE a high priced machine?)

One example is a potato harvesting machine that costs $25,000 that will replace two tractor diggers and 30 hand pickers.

What Is The Harvesting Cost Per Acre With Each System?

Hand Harvesting:

2 tractors and diggers--estimated value $10,000
(10 year life) Depreciation cost per year . . . . . $_____
Repairs per year ($50 per unit each year) . . . . . _____
Fuel and Oil ($300 per unit each year) . . . . . _____
32 hand pickers and equipment operators @ $1200 each. _____

Total cost for 400 acres . . . . . $_____

Cost per acre . . . . . $_____

Machine Harvesting:

1 harvesting machine @ $25,000 (10 year life)
Depreciation cost per year . . . . . $_____
6 men to operate at $3000 each . . . . . _____
Repairs per year . . . . . 200.
Fuel and Oil for the one unit per year . . . . . 500.

Total cost for 400 acres . . . . . $_____

Cost per acre . . . . . $_____

Financial advantage per acre of SUBSTITUTING machine for hand labor . . . . . $_____

SAMPLE QUIZ ON SUBSTITUTION

True or False:

1. __F__ All substitutions are profitable.

2. __T__ The value of the resource replaced must be greater than the value of the resource added to keep production costs at a minimum.

3. __T__ Some resources may be completely substituted.

Completion:

4. __Constant__ The total use of one resource usually results in lowest production costs when a _____ rate of substitution is applicable.

5. __Economic__ There is both a physical and _____ point of diminishing returns for substitution.

6. __Output__ There are numerous combinations of resources that can be made by the agriculturalist to arrive at the same _____.

Multiple Choice:

7. Purchasing a larger piece of machinery in order to reduce the cost required to complete a particular operation is feasible if:
   _____a. the savings in labor is less than the cost of owning the larger machine.
   _____b. there is sufficient capital available.
   _____c. the savings in labor is equal to the cost of owning the larger machine.
   __X__d. the value of labor saved is greater than the cost of owning the larger machine.

8. With a capital investment of $5000, a farmer could install an automatic feeding system for his dairy cows. It is estimated that this system would save approximately 300 hours of chore labor per year. In order for the farmer to make a sound decision on whether or not to invest in this system, he would need to consider which of the following:
   _____a. the possible return on the $5000 if invested elsewhere in the farm business.
   _____b. whether the labor saved could be profitable if utilized elsewhere in the farm business.
   _____c. the annual fixed and variable costs for operating and maintaining the new feeding system.
   __X__d. all of the above.

SAMPLE QUIZ ON SUBSTITUTION

Multiple Choice (Check Correct Answer)

1. A gasoline powered tractor burns 4 gallons of fuel per hour, and a comparable diesel tractor burns 3 gallons of fuel per hour. A farmer should consider purchasing a diesel tractor if:
   _____a. the annual fuel costs are less for the diesel tractor.
   _____b. the annual savings in fuel costs will be more than the additional annual cost of owning the diesel tractor.
   _____c. the annual savings in fuel costs will equal the total costs incurred in owning the gasoline tractor.
   _____d. the rate of operation per acre is the same with the diesel tractor as the rate for the gasoline tractor.

2. If one pound of soybean meal will substitute for 1.12 pounds of linseed meal of equivalent nutritional quality, and soybean meal is 4.8 cents per pound and linseed meal is 4 cents per pound, which practice should the farmer follow?
   _____a. feed all soybean meal.
   _____b. feed 50% soybean meal and 50% linseed meal.
   _____c. feed all linseed meal.
   _____d. feed 75% soybean meal and 25% linseed meal.

3. Machinery should be substituted for labor when:
   _____a. the value of labor saved is more than the increase in machinery cost.
   _____b. there is a plentiful supply of labor.
   _____c. the machinery is first placed on the market.
   _____d. farm prices are beginning to go downward.

Problems

4. A farmer is feeding a ration of "corn alone" to his market hogs. With this program it will require 10 bu. of corn at $1.25 per bu. to produce 100# of pork. By using a commercial supplement, he can produce 100# of pork with 5 bu. of corn and 40# of supplement costing $6 per cwt. What is the cost of producing 100# of pork in each case and what is the economic advantage for substituting the 40# of supplement for 5 bu. of corn?

A. 10 bu. corn @ $1.25 . . . . . $_____

B. 5 bu. corn @ $1.25 . . . . . $_____
   40# supplement @ $6 cwt. . . . . _____

   Total (Case B) . . . . . _____

Advantage of Substitution . . . . . $_____

(Continued)

SAMPLE QUIZ ON SUBSTITUTION--(Continued)

5. Weeds in a corn field can be controlled either by cultivating or spraying with a weed killer. To do a good job by cultivation would require one harrowing and three cultivations. The same control would be accomplished with spraying and one cultivation. What would be the cost of these two systems?

	Spraying	Cultivating
Harrowing @ $1 per acre	$-----	$_____
Cultivating @ $1.75 per acre . .	_____	_____
Cost of weed spray @ $2.50/acre .	_____	------
Cost of applying spray @ 50¢/acre	_____	------
Total cost per acre	$_____	$_____

Advantage of substituting weed spray for cultivation (per acre) . . . . . $_____

How much would this amount to on 200 acres of corn? _____

VIII. SOURCES - REFERENCES

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OPPORTUNITY COSTS

Suggested Teaching Time: 1 week

Terms Used In This Unit:

Alternative or Opportunity Cost: The cost that is measured by the income a productive factor would reserve in its best alternative employment.

Budget: An estimate of costs and returns.

Capital: An aggregation of economic goods used to promote the production of other goods.

Enterprise: A project undertaking; an important project.

Fixed Cost: A cost of production which does not vary with units of total production such as a single acre of land.

Interest: The price or rate of premium for the use of capital.

Investment: The laying out of money in a business with the view of obtaining an income or profit.

Maximize Returns: Planning so the greatest amount of return is realized on an investment.

Opportunity: A favorable juncture of circumstances; a good chance.

Profit: The excess of returns over expenditures.

Return on Investment: The income or profit realized from an investment.

I. TEACHING UNIT: PRINCIPLE OF OPPORTUNITY COSTS

II. UNIT OBJECTIVES:

A. To discover that the best use of an input resource can be achieved by selecting the most profitable opportunity areas, one after another, until the resource is exhausted.

B. To discover that the profit of a farm business is greatest when a change in the distribution of a single unit of resource would reduce farm income.

C. To discover that the expansion of one enterprise by committing limited resources decreases the opportunity to expand another.

D. To identify that a cost is incurred in not developing one enterprise in favor of another.

III. INTRODUCTION:

Technique for Introducing Unit:

Develop an example that appeals to the students. An example could be a boy wanting to buy a car and also wanting to develop his farming program at home. The boy has limited capital, cannot have both, and if he makes one of the choices, the other choice is not available to him. Thus, he has an opportunity to buy either a car or farm machinery and livestock; not both, due to limited resources. The teacher could utilize the following leading questions to assist in the introduction of this unit.

Leading Questions:

1. How many of you have a car?
2. Does a car make you any money?
3. How many of you have money invested in livestock or equipment?

4. Does this investment return you any money?

Key Questions to Assist Students in Reaching Conclusions:

1. What would be the advantages of buying a car?
2. What would be the advantages in buying livestock or equipment?
3. How could this investment be used to increase the boy's income?
4. Is it possible that the car might be used to increase the boy's income?
5. Could the car be used to obtain livestock and/or crops or vice versa?

Conclusions to be Drawn From the Above Example:

1. A boy has a choice of where to spend his money.
2. He should choose the best use for his money.

/Note to Teacher:/ Another example may serve as a thought provoking situation to capture initial interest in the principle of opportunity costs.

Example: Summer Employment Opportunities

Your brother, home from college for the summer, is faced with choices of summer work. He can work for the State Highway Department on a survey crew where his net return above travel, meals and deductions will be $89 per week for 12 weeks or $1068 for the summer. Or he can plant 20 acres of sweet corn on land rented from a neighbor. He has reason to expect to sell $6600 worth of roasting ears from this field. By the time he pays for the rent of the 20 acres, the

seed, fertilizer, insect and weed control, machinery and truck costs, packaging materials, hired labor and income tax on his expected earnings, he would have paid out or set aside $2500, leaving a net of $4100.

To accept the Highway job which seemed to yield a net of $1068 for the summer, he incurs an opportunity cost of $4100 because he did not raise sweet corn.

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The following examples are included as suggestions to assist in developing student discovery of the principle of opportunity costs. At this point the teacher must be careful not to confuse the students. The teacher should not give the student answers to memorize, but should allow time for student discussion and individual student thinking in order that each student will develop an understanding of the facts and relationships shown in the following tables and statements. Student participation should be encouraged throughout these examples.

Example #1. (Investing $2000 for Maximum Returns)

A farmer has an opportunity to invest $2000 of extra funds and wants to select the best use of the money to achieve the greatest net returns. In the example, the farmer has four choices:

A- Trade in a 2-row for a 4-row header attachment for a combine. He is now harvesting 60 acres of grain. This would save him 2 hours labor per acre and would allow him to do some custom combining worth an estimated $200.

B- Drain a 20 acre field. Presently this field is suitable only for pasture valued at $6 per acre. By draining, crop production can be increased to $30 per acre.

C- Build a silo. By adding silage to the dairy ration, the farmer estimated that his herd would produce 10,000# more milk annually.

D- Hire extra labor. By hiring additional labor it is assumed that production will be increased by $2000.

(See Calculations for Example #1 on page 115.)

TABLE 1

SUMMARY OF THE CHOICES IN EXAMPLE 1

Use of Funds	Returns From Investment	Costs of Investment	Net
Choice A of $2000 (combine attachment)	$320	$240	$ 80
Choice B of $2000 (drain field)	600	320	280
Choice C of $2000 (build silo)	450	375	75
Choice D of $2000 (hire labor)	2200	2000	200

Key Questions to Assist Students in Reaching Conclusions:

1. Which use of the $2000 would bring the greatest net return? (Choice B - draining 20 acres)

2. What would be the per cent return to investment for each of the four choices? (Drainage = 14%; Hired man = 10%; Combine = 4%; Silo = 3.75%)

/Note to Teacher:/ Show that the per cent of return equals net return divided by investment. An example would be for drainage:

$280/$2000 = 14%.

3. Since the manager had only $2000 to invest, how many opportunities could he choose if each would cost $2000?

4. What would he do about the other opportunities?

Calculations for Example #1

The following partial budgets may be used to find the net return to these investment choices:

CHOICE A: COMBINE ATTACHMENT

Returns		Expenses	
1. Save 2 hours per acre @ $1 per hour	$120	1. Yearly depreciation	$150
2. Net income from doing custom work	200	2. Yearly up-keep	60
		3. Housing and taxes	30
Total	$320	Total	$240

$320 (returns) - $240 (expenses) = $80 net profit

CHOICE B: DRAIN FIELD

Returns		Expenses	
1. $30 per acre increased production due to drainage	$600	1. Present value is $6 per acre for pasture	$120
		2. Annual use of $2000 Tile (10 year life)	200
Total	$600	Total	$320

$600 (returns) - $320 (expenses) = $280 net profit

CHOICE C: BUILD SILO

Returns		Expenses	
1. With silage the herd would produce an additional 10,000# of milk @ $4.50/cwt.	$450	1. $275 per year to fill the silo	$275
		2. Depreciation and up-keep	100
Total	$450	Total	$375

$450 (returns) - $375 (expenses) = $75 net profit

CHOICE D: HIRE LABOR

Returns		Expenses	
1. Increased production worth	$2200	1. Wages for the hired man	$2000
Total	$2200	Total	$2000

$2200 (returns) - $2000(expenses) = $200 net profit

5. When would he take advantage of the other opportunities?

6. Could the farmer afford to borrow $2000 at 6% interest to finance the hired man? to buy the combine? to build the silo? (Yes; no; no.)

7. Should the farm manager consider all opportunities for investment of capital before making a decision?

8. What would happen if the farmer over estimated returns or under estimated costs? (Here the teacher should develop the importance of an accurate budget.)

9. If the farmer could get 5% interest from the bank, should he buy a combine or build a silo even if the funds are available? (On a return to investment alone--no.)

10. If $4000 had been available, where would the manager have invested his funds to realize the greatest net profit? (Choices B and D)

11. If the farmer were interested in receiving the greatest return on his $4000, where should it be invested? (Choices B and D) Note: To arrive at decision, figure return to investment using data on Table 1.

Conclusions to be Drawn From Example #1:

1. When resources are limited in total, they must be used to the best advantage to return maximum profit.

2. Capital and other factors of production should be allocated to the high return investments.

Example #2. (Choosing Between Fertilizer or a New Variety)

A farmer has an opportunity to either use a better adapted variety of corn on 30 acres or increase the use of extra nitrogen on 30 acres of corn.

Leading Questions:

1. What variety of corn is commonly planted in this area?

2. Would you use a different variety if it would increase your yield 3 bushel per acre?

3. Which would be best: to use a better variety or to use extra nitrogen?

Choice A - Use of Funds

Use an improved variety of corn to increase yield per acre by 3 bushels. The new variety will cost the farmer $2.25 per acre more than the present variety. The following partial budget may be used to find the net return to this investment choice.

Returns		Expenses	
1. An additional yield on 30 acres of 3 bushel per acre or 90 bushel @ $1/bu.	$90	1. Cost of new variety over old variety is $2.25/acre	$67.50
Total	$90	Total	$67.50

$90 (return) - $67.50 (expenses) = $22.50 net profit

Choice B - Use of Funds

Use of an extra 40# nitrogen on 30 acres of corn to increase yield per acre by 6 bushels. Nitrogen costs 12¢ per pound.

Returns		Expenses	
1. An additional yield on 30 acres of 6 bushel per acre or 180 bushel @ $1/bu.	$180	1. 40# of nitrogen @ 12¢ per pound x 30 acres	$144
Total	$180	Total	$144

$180 (returns) - $144 (expenses) = $36 net profit

/Note to Teacher:/ Ideas to be brought out in this example are:

(a) not all investments are equal in funds needed
(b) the per cent return to investment will vary.

Key Questions to Assist Students in Reaching Conclusions:

1. Which investment returns the highest net profit? (Choice B)

2. Which investment returns the highest per cent of net return on the investment? (New variety = 33%; nitrogen = 25%.)

/Note to Teacher:/ Emphasize the importance of the net return per total investment. Have students calculate this figure for choices A and B. Place the formula of:

% of net return = $\frac{\text{net}}{\text{total investment}}$, on the board for reference.

3. If capital was limited, in which alternative would the manager invest funds? (New variety)

4. If a farmer invests in this alternative, what is the opportunity cost for not choosing the other alternative?

Conclusions to be Drawn From Example #2:

1. The per cent of net return on the investment must be calculated for good decision-making when capital is limited.

2. Decisions must be made on per cent of net return on investment and not on the net figure.

Example #3. (Choosing Livestock Enterprises)

A farmer has a 120 acre general purpose farm in the Mid-West. Some family labor and non-salable forages are available even if no livestock is produced. The farmer has $4000 of capital available for the production enterprises.

Assume that gross returns, for each $1000 invested, include annual expenses of feed, livestock depreciation, building depreciation, and labor costs.

Leading Questions:

1. What livestock would you put on this farm to maximize returns?

2. Why don't all farms have the same livestock on them?

/Note to Teacher:/ The idea to be brought out in this example is the investment opportunities at varying levels. Table 2 can be exposed one line at a time through an overhead projector.

Key Questions to Assist Students in Reaching Conclusions:

1. Where should the first $1000 be invested? (It should be invested in poultry since it grosses $1500.)

2. Where should the second $1000 be invested? (It should be invested in dairy since it grosses $1400.)

3. Where should the third $1000 be invested? (It should be invested in hogs since it grosses $1300.)

4. Where should the fourth $1000 be invested? (It should be invested in hogs also, since it grosses $1300.)

5. Would it have been best to invest entirely in hogs? Why? (No. There was a better return for the first $2000 because of extra labor and feed.)

Conclusions to be Drawn From Example #3:

1. The best input use can be determined by choosing the most profitable opportunity, one after another, until the resource is exhausted.

2. All resources must be used where they offer the highest added return.

3. The use of a resource on one enterprise prevents its use on another enterprise.

Example #4. (Opportunity Choices of a Feed Mill Operator)

The owner of the local feed mill must increase the size of his business to reduce his fixed costs. There are two possibilities he has been considering. One is to handle a line of feed for cats and dogs which would involve an interest and sales costs. The other is to sell fertilizer involving the same overhead costs. Because

TABLE 2 [1]

ADDED RETURNS FROM USING DIFFERENT AMOUNTS OF CAPITAL FOR THREE LIVESTOCK ENTERPRISES

Amount of Capital Used	Addition to Income From Last $1000 in: Hogs	Chickens	Milk Cows
$1,000	1,300	1,500	1,400
2,000	1,300	1,250	1,100
3,000	1,200	1,090	1,050
4,000	1,200	1,090	1,050
Total Returns from $4,000 Capital	$5,000	$4,930	$4,600
Average Returns Per Dollar Invested at $4,000	$1.25	$1.23	$1.15

[1] Earl O. Heady and Harold R. Jansen. Farm Management Economics, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1954) p. 78.

of space and labor he must choose one or the other. He estimates that he can sell 40,000# of cat and dog food with an interest and sales cost of $4 per hundred weight, or sell 1000 tons of fertilizer at a cost of $7.60 per ton.

Leading Questions:

1. Do feed mill operators have to keep their costs down like farmers?
2. Is there much profit in cat and dog food? In fertilizer?
3. Which choice would you make?

Comparison of Cat and Dog Feed with Fertilizer:

Cat and Dog Feed		Fertilizer	
1. Income from 40,000 lb. feed @ $8/cwt.	$3,200	1. Income from 1000 tons @ $80/ton	$80,000
Total costs (interest and sales)	1,600	Total costs (interest and sales)	76,000
Net Return	$1,600	Net Return	$ 4,000

/Note to Teacher:/ The idea to be brought out in this example is that the principle of opportunity costs applies to all businesses. The students could be asked to give other choices that the mill operator could have made. Actual figures from the local feed mill may be substituted in this example.

Key Questions to Assist Students in Reaching Conclusions:

1. Is this feed mill operator's decision-making problem similar to those a farmer faces?
2. Which enterprise returned the greatest net? (Fertilizer)

3. Would the choice have been the same if it were not? Why? (Probably not. More capital was invested in fertilizer which would have been an added cost.)

Conclusions to be Drawn From Example #4:

1. Businessmen as well as farmers must choose between investment opportunities.

2. The investment return lost by not being able to include an enterprise is an opportunity cost to the one chosen.

V. ASSOCIATION OF EXAMPLES:

To assist the student in seeing the relationships among the previous examples, the following activities are suggested:

Teacher Activity

1. Reproduce the diagram of "MAN" In Management for a presentation to the class. (located on the opposite page)

2. Class discussions of the following conclusions could help the students develop an association of the principle:

   a. The manager must decide where each unit of land, labor and capital reserve should be used to maximize profits.

   b. Borrowed funds have an extra cost: interest.

   c. Some resources are more limited in their application than others.

   d. Expansion of one enterprise decreases the opportunity to expand another if resources are limited.

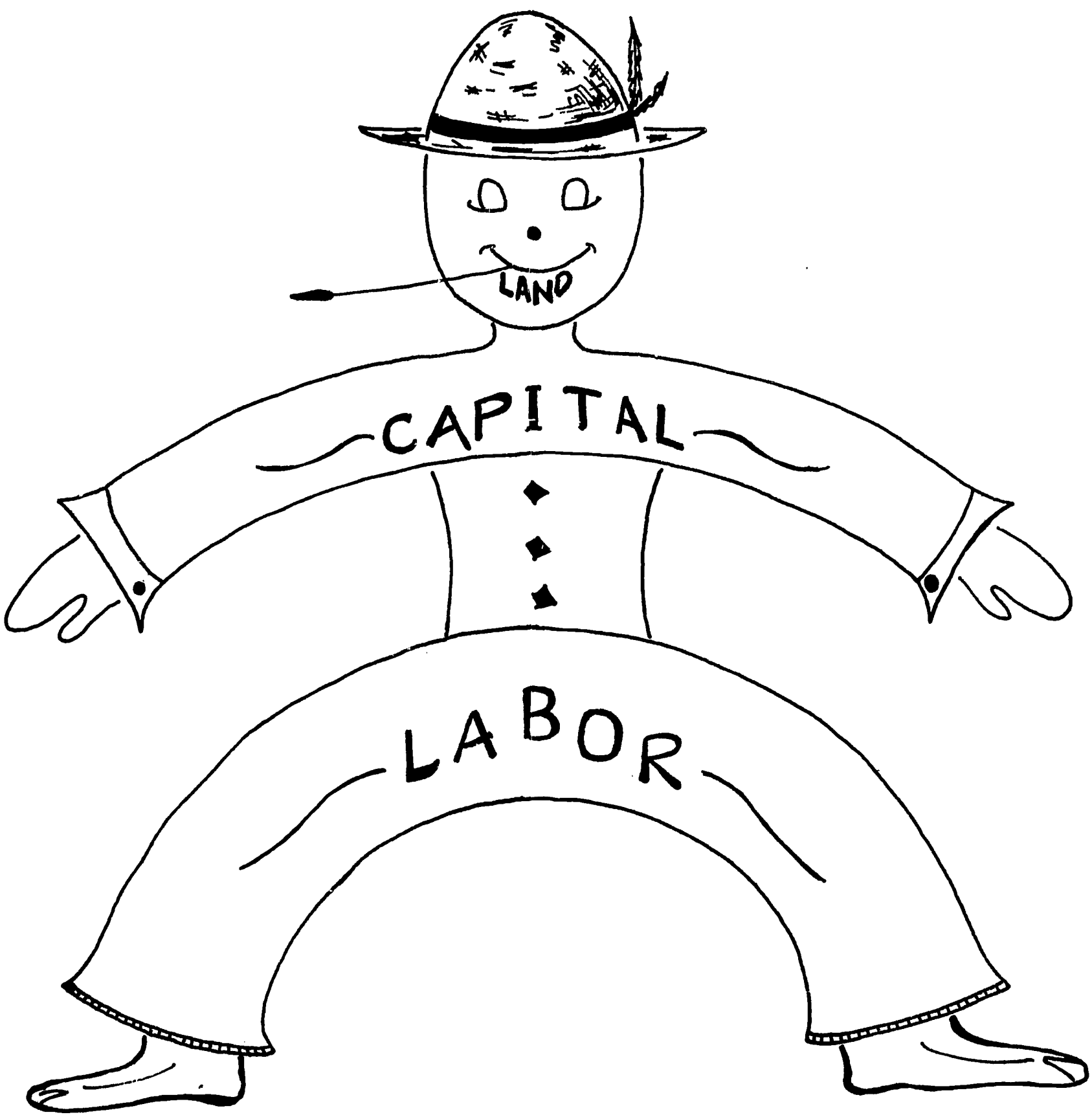
   e. A cost is incurred in not developing one enterprise (anticipated income) in favor of another.

   f. This cost applies to all investment opportunities.

3. After leading a discussion around the above points, the teacher should bring together the examples and student-derived conclusions for each, to help arrive at the commonalities existing between the situations presented in this unit. Generalizations identified will help in synthesizing the principle of opportunity costs.

The "MAN" In Management Is The One To Decide How Best To Use LAND, CAPITAL, and LABOR

"This is How I Work Best for Maximum Profit"



VI. ARRIVING AT THE PRINCIPLE:

By this time the students should be aware of the principle of opportunity costs although they probably cannot define opportunity cost as an economic principle.

The opportunity costs principle affects many profit-maximizing decisions. The students should understand the principle and be aware of how it relates to other principles.

Teacher Activity

1. Review with the students what they have observed and learned making sure they understand the terms used in this unit.

2. Have students develop some examples utilizing the principle.

3. Use these examples to develop the following facts:

   a. Resources have limitations.

   b. The total use of a resource on one enterprise prevents its use on another enterprise.

   c. The profit from the second best enterprise represents a cost that must be exceeded by the best enterprise.

   d. All resources must be used where they offer the highest added return.

4. The teacher should now develop a definition on the chalkboard with the students contributing their concept of the principle. (It is not necessary for the students to use these words, but rather define the principle in their own words.) A definition for the teacher only: "The principle of opportunity costs states that profits will be greatest if each unit of labor, capital and land is used where it will bring in the greatest added (marginal) return."

VII. STUDENT ACTIVITIES:

The following are suggested student activities the instructor may wish to use to establish the principle in the minds of the students.

Activity #1. Have the students list some situations where the principle of opportunity costs would apply. The following are examples for land, labor, and capital.

a. If barley is planted in a field, that field cannot be used for another crop.

b. If the farmer uses time for the garden, he has less time to manage the dairy herd.

c. Money spent on fertilizer for corn cannot be used to buy additional cows.

Activity #2. Have the students list areas where choices of use of capital is required. Examples:

a. breeding livestock

b. feeder livestock

c. grain production

d. building and equipment

e. machinery

f. labor

Activity #3. Have the students identify high and low return activities in a farm business from farm business analysis reports--either local or state.

Activity #4. Develop a case farm. Allow each student to spend $5000, then determine who has obtained the highest net return on the investment.

Activity #5. Have the students work budgets for enterprise choices similar to those found in the examples. A contest could be developed between class groups.

STUDENT WORK SHEET

FIGURING LABOR INCOME PER ACRE

1. Find the net return from the following partial budgets.

   a. Oats (25 acres)

      Yield: 85 bu./A @ $.75/bu.
      Seed: 2 bu./A @ $1.60/bu.
      Fertilizer: 250 lbs./A @ $58/T

   b. Wheat (25 acres)

      Yield: 35 bu./A @ $1.56/bu.
      Seed: 2 bu./A @ $2.20/bu.
      Fertilizer: 200 lbs./A @ $58/T

2. Which alternative in question number one offered the greatest opportunity cost? Why?

STUDENT WORK SHEET

COMPARING OPPORTUNITY COST OF SELECTED CROPS

(Use the information on the following page to complete this sheet.)

		CORN	WHEAT	OATS	SOYBEANS
Total income from 30 acres (yield per acre times 30 acres times the price per bushel)	(1)				
Cost of land ($20/acre) (cost per acre times 30 acres)	(2)				
Cost of seed (bu. planted per acre times 30 acres times price per bushel)	(3)				
Cost of fertilizer (pounds per acre times 30 acres = total pounds. Divide by 2000 and multiply by price per ton)	(4)				
Cost of weed killer (pounds or gallons per acre times 30 acres times price per unit)	(5)				
Harvesting costs (cost per acre times 30 acres)	(6)				
Total Costs (add 2-3-4-5-6)	(7)				
Net Profit (subtract 7 from 1)	(8)				
Net Profit Per Acre (divide line 8 by 30)					
Per Cent Return on Investment (Net profit divided by total costs)					

PARTIAL BUDGET INFORMATION SHEET

Corn (30 acres)

Yield: 110 bus./A @ $1.15/bu.
Seed: one-fifth bu./A @ $14/A.
Fertilizer: 400 lbs. of 12-12-12/A @ $72/T.
Weed killer: 2 lbs./A @ $3.50/lb.
Harvesting: $6/A.

Wheat (30 acres)

Yield: 40 bus./A @ $1.35/bu.
Seed: 2 bu./A @ $2.50/bu.
Fertilizer: 300 lbs. of 5-20-20/A @ $58/T.
Weed killer: None
Harvesting: $5/A.

Oats (30 acres)

Yield: 80 bu./A @ $.75/bu.
Seed: 2 bu./A @ $1.30/bu.
Fertilizer: 300 lbs. of 3-12-12/A @ $49/T.
Weed killer: 1 lb./A @ $1.40/lb.
Harvesting: $5/A.

Soybeans (30 acres)

Yield: 30 bu./A @ $2.45/bu.
Seed: 2 bu./A @ $4.30/bu.
Fertilizer: 200 lbs. of 0-20-20/A @ $54/T.
Weed killer: 2 gal./A @ $9.50/gal.
Harvesting: $5/A.

STUDENT WORK SHEET

DETERMINING THE BEST OPPORTUNITY FOR SUMMER INCOME

Compute the following situations to determine which one offers the greatest summer income.

1. A summer mill job at $90 per week for 12 weeks.

   Income for the summer . . . . . $_____

2. Planting, harvesting, and selling 10 acres of sweet corn.

   Income: 1000 dozen ears sold per acre at 30¢ per dozen . . . . . $_____

   Expenses:
   Rent of land--$20 per acre . . $_____
   Cost of seed--10¢ per pound, 20# per acre . . . . . _____
   Cost of fertilizer--500# per acre @ $72 per ton . . . . . _____
   Machinery cost--$12 per acre . _____
   Hired help for picking--5¢ per dozen . . . . . _____

   Total Expenses for the 10 acres . . $_____

   Net Income from Sweet Corn . . . . . $_____

3. Working for the neighbor at $1.75/hour for 40 hours/week for 12 weeks.

Situation _____ offers the greatest summer income.

If a student chooses number 3 above, is he giving up an opportunity cost? _____ Why?

SAMPLE QUIZ ON OPPORTUNITY COSTS*

Use the following chart to answer the questions below.

HYPOTHETICAL RETURNS PER $100 INVESTED

Units of Capital	Bonds	Fertilizer	Machinery	Dairy Cows	Hog Equipment
1	104	$150	$129	$170	$144
2	104	140	127	160	135
3	104	135	125	145	126
4	104	128	121	131	115
5	104	120	116	128	114
6	104	115	111	125	110
7	104	110	105	120	100
8	104	104	102	113	96
9	104	101	99	109	90
10	104	98	85	100	87
11	104	90	81	89	82

1. (A) If you had $2000 to invest, how much would you invest in fertilizer_____, machinery_____, dairy cows_____, and additional hog equipment_____?

   (B) What would be your net income at this level? _____

2. If you had $2500 capital, how much would you invest in fertilizer_____, machinery_____, dairy_____, and hogs_____?

3. If your banker will loan you $10,000 at 4 per cent interest, how much would you borrow to use for investment in bonds_____, fertilizer_____, machinery_____, dairy_____, and hogs_____?

4. Why did you limit your investments in problem number 3?

*Adapted from E. T. Shaudys and J. H. Sitterley, Farm Management. The Ohio State University, p. 30.

ANSWERS:	Bonds	Fertilizer	Machinery	Dairy	Hog Equipment	Total
1. (A)	0	$300	$100	$400	$200	$1000
(B)	0	125	29	206	79	439
2.	0	600	600	800	500	2500
3.	0	700	700	900	600	2900

SAMPLE QUIZ ON OPPORTUNITY COSTS

PROBLEM: An FFA member has an opportunity to either use a better adapted variety of corn on 30 acres or increase the use of extra nitrogen on 30 acres of corn.

CHOICE A:

The use of an improved variety of corn will increase yield per acre by 3 bushels. The new variety will cost the member $2.25 per acre more than the present variety. Complete the following partial budget.

Returns	Expenses
An additional yield on 30 acres of 3 bushel per acre @ $1/bu.	Cost of new variety over old variety is $2.25 per acre
Total $_____	Total $_____

$_____ returns - $_____ expenses = $_____ net profit.

CHOICE B:

The use of an extra 40# of nitrogen per acre will increase corn yield by 6 bushels. Nitrogen costs 12¢ per pound.

Returns	Expenses
An additional yield on 30 acres of 6 bushel per acre @ $1/bu.	40# of nitrogen @ 12¢ per pound x 30 acres
Total $_____	Total $_____

$_____ returns - $_____ expenses = $_____ net profit.

QUESTIONS:

1. Which investment returns the highest net profit?

2. Which investment returns the highest per cent of net return on the investment?

$$\% \text{ of net return} = \frac{\text{net}}{\text{total investment}}$$

3. If capital was limited, in which alternative should the manager invest funds?

4. If a farmer invests in this alternative, what is the opportunity cost for not choosing the other alternative?

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COMBINATION OF ENTERPRISES

Suggested Teaching Time: 1 week

Terms Used In This Unit:

Competitive: Referring to competition; a contest between rivals.

Complementary: Mutually supplying each other's lack.

Relationship: The mode in which one thing stands to another.

Risk: Exposure to loss.

Supplementary: Referring to supplement; that which supplies a want or makes an addition to something already established.

I. TEACHING UNIT: PRINCIPLE OF COMBINATION OF ENTERPRISES

II. UNIT OBJECTIVES:

A. To discover that the type of relationships enterprises have with each other--either competitive, complementary, or supplementary--must be identified and evaluated in order to choose a best combination of enterprises.

B. To discover that a competitive relationship exists between most enterprises in a farm-firm business.

C. To identify that either a complementary or supplementary relationship exists between enterprises that are not competitive.

D. To discover that risk or uncertainty will affect the choice of enterprises for a farm-firm business.

E. To discover that choice of enterprises must always be equated to the resources available.

III. INTRODUCTION:

Technique for Introducing Unit:

The following situation, or one altered to fit the local conditions, may be used to focus interest on this unit.

What would you do if, through inheritance or a death in the family, you found that you were responsible for the management of a 300 acre farm with 220 acres of tillable land, 60 acres permanent pasture, a full set of farm buildings, a complete line of equipment to operate this farm, enough livestock to stock the farm correctly, and a reasonable amount of money in the bank with, of course, a fairly good credit rating.

Don't take this situation too lightly! Someday, 10 to 20 years from now, several of you may be in this, or some similar situation.

Leading Questions:

1. How would you combine the enterprises of this farm to give maximum returns?

2. What crop enterprises would give the highest returns on these 220 acres and make the best use of the soil, your time and your machines?

3. What livestock enterprises would fit in best with your crops and buildings?

4. What enterprises would give you the lowest risk combination or at least, pay for the extra risk you might consider taking?

5. In what way would you combine all the enterprises on this farm to make the best use of all the resources available? (Completely use all land, labor, capital, and management.)

/Note to Teacher:/ These questions, focusing on a best combination choice of enterprises, must be faced and answered by every successful manager of a farm-firm business. The principles or relationships involved in any combination of enterprises are difficult to comprehend and apply, even in the simplest situations. Realizing that many of our students, youth and adults must make complex management decisions, we must give them a foundation on which to base choices of enterprises for their farms. This unit is not a recipe of "how-to-do" but rather a look at, or an understanding of, what a combination of enterprises is. The application of all six profit-maximizing principles to a particular farm-firm business can come only after we have successfully established these basic principles in the minds of our students. In this unit we must continue to apply ourselves to discovering and understanding the "why".

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The following examples are suggested ways to lead students through a discovery of the broad principle of Combination of Enterprises. We must keep this process simple and understandable; but at the same time, include enough material to make it meaningful.

This teaching unit is by no means intended to be a complete and comprehensive study of this principle. This would involve presenting so much information and so many examples that the student would get lost in the complexity of it all. It is suggested that the teacher adjust this section of the unit to the educational level of his students by adding more complex examples where applicable.

Example #1. (Competitive Relationship of Enterprises)

You must decide whether to raise sheep or beef brood animals. They would both compete for your labor, pasture, and investment capital.

Leading Questions:

1. How many of you have either sheep or beef at home?
2. Are the resource needs of sheep and beef similar? How?

TABLE 1

RESOURCE NEEDS OF SHEEP AND BEEF

Item	Labor	Capital	Acres of Pasture	Net Profit
1 ewe	4 hrs.	$150	.2 acres	$ 7.50
1 cow	13 hrs.	$790	1.0 acres	$33.00

/Note to Teacher:/ The idea to be brought out in this example is the competitiveness of selected factors of production. The following calculations may be made with the students to show which enterprise competes best for the resources as shown in Table 1.

Calculations

For Labor:

Sheep - net $7.50 ÷ labor 4 hrs. = $1.87/hr.

Beef - net $33.00 ÷ labor 13 hrs. = $2.54/hr.

Beef competes best for labor.

For Pasture:

Sheep - net $7.50 ÷ pasture .2 A. = $37.50/A.

Beef - net $33.00 ÷ pasture 1.0 A. = $33.00/A.

Sheep competes best for pasture.

For Capital:

Sheep - net $7.50 ÷ capital $150 = $.05/$1 invested

Beef - net $33.00 ÷ capital $790 = $.04/$1 invested

Sheep competes best for capital.

Key Questions to Assist Students in Reaching Conclusions:

1. Was beef most competitive for all factors of production?
2. Was sheep? (No, not for labor.)
3. Why were other factors of production, such as housing, etc., not considered here? (Because the enterprises were not competing for them.)
4. Why must he choose between beef or sheep? (There are not enough resources for both.)

5. Why can sheep and beef be substituted for each other? (They use the same resources.)

6. Does this make them competitive? (Yes)

7. On what basis should a farmer determine whether to have sheep or beef? (Maximum net profit.)

8. What other principles were applied in this example? (Principles of opportunity cost and substitution.)

Conclusions to be Drawn From Example #1:

1. Enterprises can be competitive for one or more resource.

2. A given enterprise may be more competitive for one or more of the production resources than other enterprises.

3. When an enterprise has a competitive relationship with others, we can evaluate its relative profitability.

4. In choosing between competitive enterprises, we apply the principle of opportunity costs and substitution.

Example #2. (Competitive Relationship of Crops)

You have 200 acres of cropland on which you have decided to plant either corn, soybeans, or a combination of both. You are fortunate to have the facts from Table 2 on which to base your decision.

Leading Questions:

1. How many of you raise corn or soybeans at home?

2. Do they both make the same income?

3. Why do we sometimes raise both corn and soybeans? (Reduce competition for time, management and machinery.)

/Note to Teacher:/ The lower yields in Table 2 may be explained as resulting from competition for time, management, and machinery.

TABLE 2

INCOME FROM VARYING COMBINATIONS
OF CORN AND SOYBEANS

Corn				Soybeans			Total
Acres	Yield	Income		Acres	Yield	Income	Income
50	100 bu.	$2000	+	150	40 bu.	$4500	$6500
100	100 bu.	$4000	+	100	45 bu.	$3000	$7000
150	80 bu.	$4800	+	50	45 bu.	$1500	$6300

Key Questions to Assist Students in Reaching Conclusions:

1. Which combination returned the maximum income? (The combination of 100 acres each of corn and soybeans.)

2. Would the relationship of corn and beans change if corn were $1 a bushel and beans $2 ? (Yes)

3. Would the relationship change if the crop yields were changed? (Yes)

4. Would the relationship change if the costs of production changed? (Yes)

Conclusions to be Drawn From Example #2:

1. When yield levels vary, the decision process is complicated.

2. To make an accurate choice between combinations of enterprises, we must consider factors of production, yields, and market prices.

3. At each level of acres of land use for crops, we have a different relationship.

Example #3. (Supplementary Relationship)

Student discovery of the supplementary (non-competitive) relationship may proceed as follows:

After you make a choice between beef and sheep you find that you have more than enough labor to care for the animals that your pasture will support. Your land and capital are used to capacity, but you have extra labor.

Looking around, you find that you have a small shed suitable for farrowing sows. You also have 5 market gilts that could be bred and kept for brood animals.

Leading Questions:

1. What additional resources would be needed by adding a brood sow enterprise to the ewe-cow program? (a. land

and buildings - none; b. extra capital - none because he has 5 gilts; c. labor - enough available to care for sows.)

2. What could we call an enterprise that does not compete with any other for resources? (Supplementary)

Key Questions to Assist Students in Reaching Conclusions:

1. Why was this enterprise not competitive? (It used only those resources not being presently used.)

2. Since large operations are usually more efficient, why couldn't you have 35 sows instead of 5? (The extra animals would compete for land, capital, labor, and probably management presently used by the beef and ewes.)

3. Would the cost of the unused resources for a supplementary enterprise (such as sows) be the same as for a competitive enterprise? (No, because the costs, such as overhead, would be carried by the beef and sheep even if the hogs were not raised.)

4. What are some other enterprises that could have a supplementary relationship in a combination of enterprises? (Small poultry enterprise, strawberry patch, shoeing horses, etc.)

Conclusions to be Drawn From Example #3:

1. An enterprise that is supplementary does not compete with other enterprises for any factor of production.

2. When a supplementary enterprise starts competing for production resources, it becomes a competitive enterprise.

3. If a supplementary enterprise is expanded sufficiently, it eventually will change to a competitive enterprise.

4. Supplementary enterprises need only have returns greater than the costs to be justly included in a combination of enterprises.

5. Supplementary enterprises make use of resources that otherwise would not be used.

Example #4. (Complementary Relationship)

Some enterprises have a predominantly complementary relationship to other enterprises.

After setting up an acceptable combination of crop enterprises, you find that wheat returns a low profit. It does, however, give protection to the new hay crop and provides income otherwise lost.

Leading Questions:

1. Should you raise wheat?
2. Should we base this decision on the cash profit from raising wheat?

TABLE 3

COMPLEMENTARY EFFECT OF WHEAT AND HAY CROPS

	Wheat Alone	Hay Alone	Combined
Net Income For First Year	$40/acre	$20/acre	$45/acre

/Note to Teacher:/ The students may give other complementary enterprises such as: a. corn and beef; b. corn and hogs; c. legumes and corn; or even a small scavenger flock of sheep.

Key Questions to Assist Students in Reaching Conclusions:

1. If you want to grow hay, why complicate it by growing wheat too? (Wheat will act as a complementary enterprise and raise net profit.)
2. Would this type of enterprise change if it were difficult to get labor and machinery to harvest the grain? (Yes. It then becomes competitive.)
3. Can an enterprise be both complementary and competitive? (Yes)

Conclusions to be Drawn From Example #4:

1. A complementary enterprise will add to the total production of an enterprise combination.

2. A complementary enterprise can become competitive if expanded.

3. A complementary enterprise can be competitive while at the same time complementary.

Example #5. (Effects of Risk and Uncertainty)

You wish to add a livestock enterprise to your farm business. The choice has been narrowed to dairy, calves, hogs, and lambs. You will choose only one of these enterprises because they are competitive for your farm resources. You have the information from Table 4 giving the relative uncertainty of the enterprise choices. You will make your choice based on risk alone.

Leading Questions:

1. Have you ever taken a chance? (a risk)

2. What are some risks a farmer takes?

3. What might be the results of some of these?

/Note to Teacher:/ The idea to be brought out in this example is that risk is a factor in choosing among enterprises. Table 4 shows the variation of net income experienced by several farmers as a result of imperfect knowledge (risk).

Key Questions to Assist Students in Reaching Conclusions:

1. Based on the information from Table 4, which enterprise would have the greatest risk? Why? (Lambs; income varied 42% from $87 profit to $74 loss.)

2. Which would have the least risk? Why? (Dairy; income varied only 13% from $44 profit to 0 loss.)

3. Which enterprises would a farmer with limited capital choose? Why? (Hogs or dairy because of the lower risk.)

4. Which enterprise would a farmer choose if his capital were not a limiting factor? Why? (Calves or hogs because of a chance of higher profits - risk.) Note: Profit is proportional to risk involved.

5. What are some ways to reduce risk? (Insurance, contracts, diversification, hedging, etc.)

6. In reducing risk, are there costs involved? (Yes. Anything reducing risk would add to costs.)

Conclusions to be Drawn From Example #5:

1. Decisions or outcomes of an enterprise cannot be predicted perfectly.

2. With unlimited resources, more risk can be assumed by the farm manager.

3. Insurance, hedging, diversification, flexibility, contracts, discounting, can be used as a risk safeguard or precaution.

4. Imperfect knowledge must be considered as an added cost to any enterprise when choosing a best combination of enterprises.

Example #6. (Selection Based on Available Resources)

A young farmer has just purchased a farm. He is debating whether to raise hogs or produce milk. In Table 5 he has facts from Extension studies on which to base his decision. He has inventoried the resources he has available as follows:

1. He has mostly class III land which requires hay in rotation.
2. His crop land is limited.
3. He is accustomed to milking cows - he has experience.
4. Sufficient capital is available to operate this farm.
5. Ample low cost labor is available.

TABLE 4

RISK IN RETURNS FROM LIVESTOCK

Enterprise	Average Net Return For Each $100 Cost	Maximum Net For Each $100 Cost	Minimum Net For Each $100 Cost	Variability Per Cent
Dairy	$20	$ 44	$ 0	13%
Fed Calves	31	121	- 70	37%
Hogs	42	109	- 26	23%
Fed Lambs	29	87	- 74	42%

TABLE 5

RESOURCE NEEDS OF DAIRY AND HOGS

Enterprise	Corn Land	Hay Land	Pasture Land	Labor Per $100 Net	Capital Per $100	Management Per $100
Dairy	15%	33%	52%	31 hours	$10	2 hours
Hogs	70%	0	20%	4 hours	$ 7	4 hours

Leading Questions:

1. What resources do farmers have to work with?

2. Do all farmers have the same amount of each resource?

/Note to Teacher:/ The concept that a best choice of enterprises is based upon the resources available is the theme of Example #6.

Key Questions to Assist Students in Reaching Conclusions:

1. Judging from the resource list, what resources does this farmer appear to have in sufficient amounts? (Hay, land, management ability for dairy, capital, and labor.)

2. What resources are limited? (Crop land and experience with hogs.)

3. Which enterprise would you choose? Why? (Dairy. It is the best use of total resources.)

4. After a best combination of enterprises is found, would a change in the combination affect profits? How? (Yes; it would reduce profits.)

Conclusions to be Drawn From Example #6:

1. The kind and amount of resources available in a farm-firm business usually determines the best combination for that business.

2. Maximum returns are greatest when the returns to the most limiting resource are greatest.

3. There is no one best combination of enterprises that will fit every farm business' available resources.

4. There is a most profitable combination of enterprises for a given farm business and all other combinations will result in lower net returns.

5. Under certain conditions, some enterprises make better use of resources than do other enterprises.

V. ASSOCIATION OF EXAMPLES:

This principle is not as simple and clear-cut as the previous principles that have been developed with the students. In a sense, it entails all of the previous profit-maximizing principles. This principle, like the time comparison principle, involves relationships of enterprises. In associating the examples, we must remember we are dealing with the application of several principles. The following questions could be asked to show how the above examples are associated.

Questions to Pose:

1. Do enterprises have different relationships to one another?
2. Do enterprises that compete have the same relationships as those that supplement or complement each other? Why?
3. Does an understanding of these relationships assist in choosing a best combination of enterprises?
4. How does risk and uncertainty affect decision-making?
5. Why does the choice of enterprises depend on the resources available?

VI. ARRIVING AT THE PRINCIPLE:

The principle of combination of enterprises is involved, in part, in each of the previous examples. Because of the complexity of this principle, it cannot be spelled out as clearly as the previous principles.

Teacher Activity

1. A review of terminology of this unit and all previous units should be made.

2. Have students prepare individual definitions of the principle of combination of enterprises. From these, derive a definition similar to the one below.

3. A specific definition of the combination of enterprises principle is: "The best combination of enterprises is achieved when a farm business is so organized that the farm manager cannot add to or expand the size of one enterprise or delete or contract another enterprise without reducing the total net farm income."

VII. STUDENT ACTIVITIES:

By applying the principle to realistic situations, students will develop better understanding. The following problems are suggested student activities the teacher may wish to use.

Problem #1. Assume that a farmer has a 500 acre general livestock farm. His most scarce resource is labor. He has 200 acres of crop land. According to his past records, he can raise 1 acre of corn for $50 and get $120 worth of corn; 1 acre of oats for $30 and get $64 worth of oats; 1 acre of wheat for $30 and get $80 worth of wheat; and 1 acre of hay for $40 and get $80 worth of hay. Plan a cropping program in which he can make the most use of his labor by receiving maximum profit.

Problem #2. A class developed case farm, if it is being used to teach farm management, would be the perfect student activity for applying this principle.

Problem #3. As an employee of a farm management firm, you are given the task of developing a complete farm plan for a fairly successful farmer who feels his farm isn't making as much money as it should.

Using the information from Tables 6, 7, 8, and 9, and the Farm Map, develop:

1. A cropping system
2. A livestock plan
3. A labor requirement and distribution chart
4. An expected income from crops and livestock sales.

/Note to Teacher:/ This problem farm can be used:

1. As a contest between students to see who would have the most income
2. As an individual study project
3. As a quiz.

Other items could be figured for this farm such as machinery investment, total capital investment, etc.

TABLE 6

CHOOSING LIVESTOCK ENTERPRISES THAT FIT YOUR FARM

	DAIRY	SHEEP	BEEF COW	BEEF	FEEDER PIG	HOG
Unit	Milk Cow	Ewe	Cow	Cow	Sow	Sow
Production	12,500#M.	90# Lamb 120% Lamb Crop 8# Wool	450# Calf 90% Calf Crop	950# Beef	14 Pigs 40#	14 Market Hogs
Feed[1]						
Corn	50 bu.	4 bu.	4 bu.	44 bu.	40 bu.	205 bu.
Hay	7200#	800#	4500#	6500#	------	--------
Pasture	1.7 Acre	.26 Acre	1.7 Acre	1.7 Acre	.67 Acre	.67 Acre
% Land[2] In						
Corn	15%	9%	2%	14%	37%	75%
Hay	33%	29%	28%	31%	---	---
Pasture	52%	62%	70%	55%	63%	25%
Hours Labor	80	4	13	23	15	32
Capital	$1750	$150	$790	$1226	$750	$1500
Gross	$575	$25	$110	$195	$227	$500
Net	$172.50	$7.50	$33	$48.75	$56.75	$125
Units to = $6000 Net	35	800	182	123	106	48

[1]Pasture is alfalfa and grass, untreated permanent pasture would require 3 times as many acres, fertilized and limed pasture permanent 1½ times as many acres.

[2]Yields used were corn 100 bu., hay 3.3 tons, pasture .75 animal units.

TABLE 7

LIVESTOCK REQUIREMENTS USED IN PLANNING

Kind of Livestock	Feed(1) Bu. Corn	Feed(1) Ton Hay	Feed(1) # Supp.	Bunk or Feeder Space	Bedding Material	Water Space Per Animal	Pasture A.U.	Housing (2) & (3)
1400# Dairy Cow 16,000# 3.5%	58	3-4	1650	24"-36"	Stanchion 1,000# Loose 4,000#	Stanchion 2/cup Loose 25/cup 25/sq. ft.	1	Surfaced Lot 50-100 sq. ft. Resting area 40-75 sq. ft.
13,000# 3.5%	44	3-4	1250					
10,000# 3.5%	35	3-4	980					
Dairy Heifer	6	1½-2	75	20"-30"	1000#-1500#		2	Surfaced Lot 35-80 sq. ft. Resting area 20-40 sq. ft.
Dairy Calf	6	½-1½	75	16"-20"	100-300	5/cup	4	Box stall 15-100 sq. ft.
Beef Cow with Calf 400#	4	2-2½		24"-36"	2000-2500	25/cup	1.20	Surfaced Lot 35-100 sq. ft. Resting area 20-40 sq. ft.
Feeder Calf 400# Gain	40	¼-½	275	18"-22"	2000-2400	25/cup	3	Surfaced Lot 35-50 sq. ft. Resting area 12-20 sq. ft.
Yearling Feeder 350# Gain	40	½-3/4	250	22"-24"	2400-2700	25/cup	2	Surfaced Lot 35-80 sq. ft. Resting area 15-25 sq. ft.
Heavy Steer 300# Gain	36	3/4-1	200	24"-36"	2700-3000	25/cup	1	Surfaced Lot 35-100 sq. ft. Resting area 20-40 sq. ft.
Sow & 16 pigs to weaning	30		210	3 per ft.	100# Per 1000# Gain	Gravity 25 to 1 cup		Farrowing area 42 sq. ft. Shade area 8-12 sq. ft.
Feeder Pigs 40-210#	10-13		70-80	3-5 per ft.		Pressure 40 to 1 cup	15	Resting area 6-8 sq. ft.
Ewe & Lamb to weaning	7.7	¼		Hay 18"-24" Grain 14"-18"	100#		5.5	Surfaced Lot 15-22 sq. ft. Resting area 15-22 sq. ft.
Feeder Lamb 30# Gain	2.5	.075	20	12"-18"	23#	25/cup	10	Lot: Surfaced 6-8 sq. ft. Building: 5-8 sq. ft.
Replacement Lambs		.175		Hay 12"-14" Grain 10"-12"	23#		12	Soil 8-15 sq. ft.
Broilers 3#	.06		4.5	2"	300# per 1000 birds	10¢ per Fountain		7-10 sq. in./bird
Hens (Light)	.76		12.5	3"	10	150 per Fountain		1 sq. ft./bird; Single nest 1/5 birds
Hens (Heavy)	.91		51.0	4"	10	150 per Fountain		2½ sq. ft./bird; Community nest .18 sq. ft.

(1) Feed requirements based on average hay equivalent.
(2) Specified as to good area drainage.
(3) Minimum resting area does not include feeders.

TABLE 8

TIME USED IN FIELD WORK*

Job Done	Size of Tractor Used[1]	Man Hours Used Per Acre Average
Plow with 2-14" plows	2	1.25
Plow with 3-14" plows	3	.92
Plow with 4-14" plows	4	.58
Disk with 7 or 8-foot disk	2,3	.39
Disk with 9-foot disk	3	.31
Disk with 10-foot disk	,4	.28
Disk with 12-foot disk	4	.24
Drag with 10-foot drag	2	.39
Drag with 12-foot drag	2,3	.32
Plant corn and soybeans, 2-40' rows	2,3	.55
Plant corn and soybeans, 4-40" rows	2,3	.29
Rotary hoe corn and soybeans, 2 rows	2,3	.27
Rotary hoe corn and soybeans, 4 rows	2,3	.15
Cultivate corn and soybeans, 2 rows	2,3	.49
Cultivate corn and soybeans, 4 rows	2,3	.26
Spray corn with 6-row sprayer	2,3	.17
Pick corn with 1-row picker	2,3	1.65
Pick corn with 2-row picker	2,3	.90
Store corn on farm	2,3	1.18[3]
Sow small grain and soybeans, 12 x 7 drill	2,3	.54
Sow small grain and soybeans, 15 x 7 drill	2,3	.46
Sow small grain and soybeans, 17 x 7 drill	2,3	.37
Combine with 5-foot combine	2,3	1.06
Combine with 6-foot combine	2,3	.90
Combine with 7-foot combine	2,3	.75

(Continued)

TABLE 8--(Continued)

Job Done	Size of Tractor Used[1]	Man Hours Used Per Acre Average
Combine with 10-foot combine	SP[2]	.46
Combine with 12-foot combine	SP	.42
Store small grain and soybeans on farm	2,3	.80[1]
Mow hay and straw with 7' mower	2,3	.50
Rake hay and straw with 7' rake	2,3	.45
Bale hay and straw	2,3	.50
Store hay on farm	2,3	1.90[4]
Store straw on farm	2,3	1.30
Seed meadow with broadcast tractor seeder	2,3	.16

[1]Stated in number of plows tractor is rated to pull.

[2]Self-propelled.

[3]Tractor time .86 hours.

[4]Tractor time .55 hours.

*Reprinted from Ohio Farm and Home Research, January - February, 1961, Vol. 46, No. 1.

TABLE 9

LABOR DISTRIBUTION

Labor requirements for each month:

Will this operator:

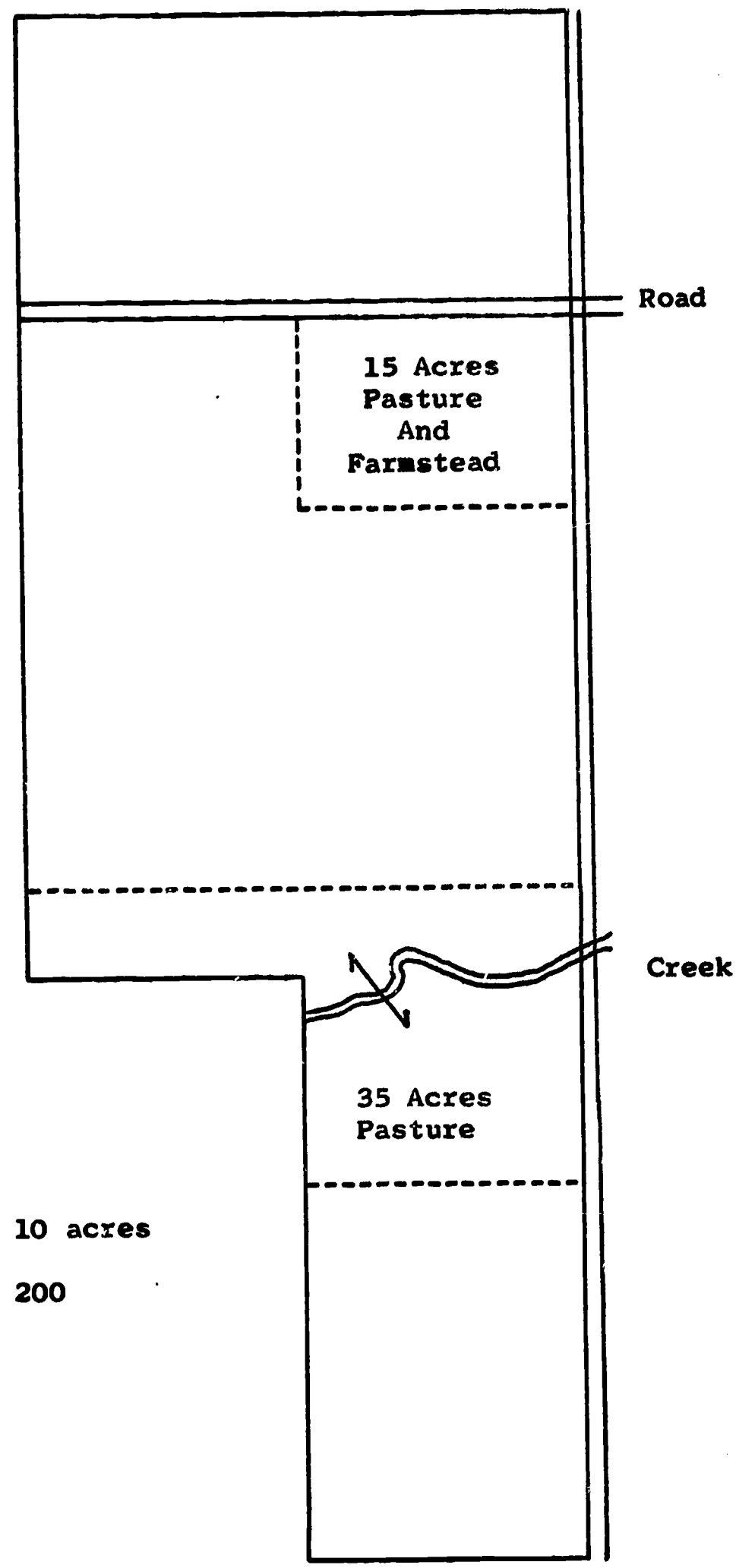
1. **Be able to do all the work himself?**
2. **Need to hire some part time help during peak seasons?**
3. **Need to hire help for the entire year?**

One man working 10 hours per day would work 300 hours per month.

Labor required per month:

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
For Crops												
For Livestock												
Total												

FARM MAP



1 square inch = 10 acres

Total Acres = 200

STUDENT WORK SHEET

COMBINING ENTERPRISES (Problem No. 1)

Use the following information to complete problems 1 and 2 below.

Animal Units: Equivalent numbers that require the same amount of feed, pasture, or labor.

Dairy Cows	Sheep	Sows
one	five	three

Each animal unit requires 1 acre of pasture and 50 bu. of corn. Corn yields at 100 bu. per acre.

1. How many acres of corn and pasture will be required for:

	No. Animal Units	Acres of Pasture	Bu. Corn
20 dairy cows	_____	_____	_____
80 sheep	_____	_____	_____
9 sows	_____	_____	_____
Total	_____	_____	_____

Total Acres of Pasture Required _____

Total Acres of Corn Required _____

2. A farm is purchased that has 40 acres of pasture land and 25 acres of corn ground. The owner wants to have dairy cows and sows on this property. How many of each can he have on this acreage?

	Animal Units	Acres Pasture	Acres Corn
____ dairy cows	_____	_____	_____
____ sows	_____	_____	_____
Total Acres		40 Acres	25 Acres

STUDENT WORK SHEET

COMBINING ENTERPRISES (Problem No. 2)

Problem:

Develop a crop and livestock plan for the farm situation below. A combination of both crops and livestock must be used.

The Farm:

150 acres of which 20 acres are in permanent pasture. The remaining 130 acres can be used for crops or for pasture.

Pasture Requirements:

1 dairy cow per acre
5 sheep per acre
No pasture for hogs or beef steers.

Feed Requirements:

Hay - 2 dairy cows per acre
10 sheep per acre
8 beef steer per acre
No hay for hogs

Corn - 2 dairy cows per acre
10 sheep per acre
5 sows per acre
4 beef steers per acre

Net Return From Livestock Per Year:

1 dairy cow	- $120
1 sow and pigs	- $ 70
1 ewe and lambs	- $ 10
1 beef steer	- $ 30

Net Return From Crops Per Acre:

Wheat	- $19.40
Oats	- $28.60
Corn	- $42.30
Soybeans	- $33.80

SAMPLE QUIZ ON COMBINATION OF ENTERPRISES

True-False

1. T The use of a resource on one enterprise prevents its use on another enterprise.

2. T The profit from the second best enterprise is a cost to the best enterprise.

3. F When a farmer can change his investment or labor input without reducing income, he is operating at peak production.

4. T Interest is the cost of borrowed money.

Completion

5. When resources are limited, the expansion of one enterprise reduces the expansion of another.

6. Capital should be allocated where it will return the highest per cent on investment.

7. With competitive enterprises and limited resources, more corn fed to hogs means less corn to feed to cattle.

8. The manager must decide where each unit of the productive resources of land, labor, and capital can be used to maximize returns.

Problems

9. A farmer is considering planting 30 acres of sorghum instead of corn. In preparing a partial budget, he determined the following information. The production costs for corn would be $800 with a gross return of $1500. The production costs of sorghum would be $500 with a gross return of $900.

	Corn	Sorghum
A. What would be the net return?	$700	$400
B. What would be the per cent return on investment?	87%	80%
C. Which crop should the farmer plant? Why?	X	

(Continued)

SAMPLE QUIZ--(Continued)

10. Combining crop enterprises to reduce uncertainty is advantageous particularly for:
    _____a. the beginning farmer with ample capital.
    _____b. a tenant farmer with specialized machinery.
    _____c. a farmer with unlimited capital.
    __x__d. a farmer with limited capital.

    Why?

SAMPLE QUIZ ON COMBINATION OF ENTERPRISES

Multiple Choice (check correct answer)

1. The farmer's profits will be greater if each unit of labor, capital, and land is:
   _____a. used on one enterprise where production can be concentrated.
   _____b. used evenly in a number of enterprises to spread out risks.
   __x__c. used where it will add the most to net returns as determined by the situation.
   _____d. concentrated in one major enterprise.

2. A method for a farmer to lower risks would be to:
   _____a. concentrate on one type of livestock enterprise.
   _____b. concentrate on one type of crop enterprise.
   _____c. have one type of livestock enterprise and grow feed for it.
   __x__d. have supplemental livestock and crops which best fit into the major system.

3. The most important factor to consider in choosing enterprises to combine into a farm business is:
   _____a. labor distribution.
   _____b. personal preference.
   __x__c. relative opportunity as compared with competing enterprises.
   _____d. capital outlay necessary to begin new enterprise.

4. A dairyman is milking an average of 40 head of dairy cows monthly and is not utilizing his good hired man efficiently during the winter. He has a large poultry house which is not being used presently and has, also, a surplus of corn. What should he do?
   _____a. expand his dairy herd.
   _____b. custom hire his corn production.
   __x__c. buy 50 to 100 feeder pigs in late fall to feed out each winter.
   _____d. sell the surplus corn and let the hired man rest some in the winter.

5. By diversifying crop enterprises rather than specializing in one major crop, the crop farmer will:
   __x__a. reduce risk and uncertainty.
   _____b. decrease annual labor efficiency.
   _____c. facilitate the use of more labor saving equipment.
   _____d. concentrate production knowledge.

(Continued)

SAMPLE QUIZ--(Continued)

6. On a large cash grain and hay farm where summer labor is limited, which one of the following enterprises would fit in the best, providing adequate facilities and equipment exist?
   x a. sheep
   ___ b. dairy cattle
   ___ c. hog feeding
   ___ d. laying hens

7. Which one of the following is not one of the four basic production functions used in agriculture?
   ___ a. land
   ___ b. labor
   ___ c. management
   x d. weather
   ___ e. capital

8. An example of competitive enterprises is:
   ___ a. hogs and corn
   x b. dairy and beef cattle
   ___ c. dairy cattle and corn
   ___ d. potatoes and poultry

9. Many farmers place a few hogs in the cattle feeding lot, particularly if the cattle are fed whole corn. The relationship between these enterprises is:
   ___ a. competitive
   ___ b. marginal
   x c. complementary
   ___ d. supplementary

10. The various combinations of inputs that can be used in order to produce a given quantity of output is known as a:
   ___ a. enterprise
   x b. production function
   ___ c. supply and demand
   ___ d. profit-maximizing principle

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TIME RELATIONSHIPS (TIME COMPARISON)

Suggested Teaching Time: 1 week

Terms Used In This Unit:

Alternative Investment Opportunity: A choice of two or more opportunities. If one is selected, the others are rejected, or a lesser investment may be made in each of the opportunities.

Discounting: To take in advance at less than the full value; to lend money, deducting the interest in advance. Figuring the present value of income or costs which occur in the future.

Future Value: Cost or value at a future time. Includes the original investment plus any interest payments.

Interest: The price or rate of premium for the use of capital.

Investment: The laying out of money or capital in order to secure profitable returns.

Present Value: The cost or value now.

Return on Investment: The income or profit realized from an investment.

I. TEACHING UNIT: PRINCIPLE OF TIME RELATIONSHIPS

II. UNIT OBJECTIVES:

A. To calculate the present value of a future cost.

B. To calculate the future value of a present cost.

C. To discover that present value and future value may apply to income as well as cost.

D. To discover that interest rate and length of time determine the investment cost or return of an investment.

E. To discover that interest rate is determined by choosing the best investment opportunity available when capital is limited.

F. To apply the time comparison principle by comparing the present value of a future income or cost with the future value of a present income or cost in a situation where capital is limited.

III. INTRODUCTION:

Technique for Introducing Unit:

The time comparison principle should be introduced by showing the effect of interest costs or returns on a one year basis. The examples under teaching - learning activities will bring out the other aspects of the principle.

Leading Questions:

1. How many of you plan to own a car in the next four years?
2. What will this car cost?
3. Is this the only cost? (Bring out the interest cost.)
4. What is interest?

Situation: You have just bought a used car for $800 and will pay for it in one year. The interest rate is 12% because of the type

of loan. (The rate on car loans of $6 per $100 per year figures out at about 12% as a true rate of interest.)

Key Questions for Discussion:

1. Will you pay more than $800 as a result of buying the car? Why? (Yes; interest costs.)
2. How much will the total cost of the car be? ($896)
3. At what date will this be the car's total cost? (At the end of the year)
4. What would you pay for the car if you had the cash? ($800)
5. What cost does $896 represent? (The future cost)
6. What cost does $800 represent? (The present cost)
7. Why are they different? (The $96 represents the investment cost over a period of time - 1 year.)

IV. TEACHING - LEARNING ACTIVITIES (EDUCATIONAL EXPERIENCES)

The principle of time comparison is more complicated than the previous principles. The following examples are suggested to show realistic application and lead the student through a process of discovering the principle. The teacher may wish to change some examples or add others to increase the effectiveness of this unit.

Example #1. (Future and Present Cost of a Car)

In this example, a comparison is shown between the future cost and present cost of a car priced at $2800.

Leading Questions:

1. If you don't have the money to buy a car, what can you do? (Borrow it.)

2. Does it cost to borrow money? Why? (Yes; the money could be loaned to someone else.)

3. If you put money in a savings account, what do you get? (The bank pays you interest.)

4. Does money make money? (Yes)

Situation A. (Determining Future Cost): You have the money to buy a new car for $2800. What will be the total cost of this car at the end of the year if you could have invested that money at 6% interest?

Calculations

Investment	$2800	Price of Car	$2800
		Investment lost during the year	168
Interest Rate	.06		
Investment Value	$ 168	Future cost of New Car	$2968

Situation B. (Determining Present Value or Cost): You decide to set aside (invest) $2800 now to buy the car at the end of the year. How much will you have to invest right now at 6% interest?

Calculations

$2800 = price of car

PV = present value or cost of car

.06 = interest rate

$$PV = \frac{\$2800}{1 + .06} = \$2641.50$$

$2641 represents the dollars needed now in order to buy the car at the end of the year.

/Note to Teacher:/ The idea to be brought out in this example is that cost changes with time. The formula in Situation B will be explained later. Simply ask students to accept it as fact until later. Have students calculate similar interest problems to develop understanding at this point. Have problems for one year only.

Key Questions to Assist Students in Reaching Conclusions:

1. Did the car have more total cost in Situation A or Situation B?

2. Why did it cost more in Situation A? (Time involved)

3. Was time important in the difference in these costs? Why? (Yes, it changes the value of interest.)

4. Was the rate (per cent) of interest a factor? (No; it didn't change.)

5. What would the cost be if there were no investment alternatives--no place to invest? (The value would always be $2800.)

Conclusions to be Drawn From Example #1:

1. The length of time that money is invested will determine the total value of an investment.

2. Time affects the value of an investment only if we have alternative investment possibilities. (If there is no other place to put the money, there will be no opportunity cost.)

3. Interest rate and time determine the value of an investment.

4. If there are no alternative investment opportunities, the value of an investment remains constant.

5. The interest from a bank account will help to pay for a car if money is deposited and left for a period of time before making the purchase.

Example #2. (Future and Present Cost for More than One Year)

In example #2, Situation A shows how interest is calculated for more than one year (figuring future cost based on present value). Then, in Situation B, we reverse the process and show how to discount a future cost to give us a present value (Situation A worked backwards).

Leading Questions:

1. How many of you have ever bought a tractor? a cow? hogs?
2. Which would require less money--to buy a tractor now or raise livestock for a few years and then buy the tractor? (Wait a few years)
3. Why doesn't everyone wait? (The tractor is needed. It will give more returns than anything else.)

Situation A. (Future Cost of a Tractor Bought Now): A young farmer is buying a tractor for $2800. He plans to keep it four years. He could have invested that $2800 for four years to expand his farming operation and received a 10% return on that investment. What would the future cost of the tractor be if we added the 10% investment return as a cost for four years? (See calculations on next page.)

/Note to Teacher:/ Point out that $4099.48 invested over the four years is worth $2800 today if it could have been invested at 10% return (interest)--the future cost based on the present value.

Situation B. (Present Cost of a Future Tractor Purchase): The young farmer decided not to purchase the tractor. Instead, he decided to buy hogs which would return 10% on his investment. Then, at the end of four years he would pay the $2800 for the tractor. What amount of money would he have to invest now to have $2800 in four years? The following formula is used to find this value.

PV = present value
q = future cost
rate = % interest
n = years invested

$$PV = \frac{q}{(1+rate)^n}$$

Substitute Figures:

$$PV = \frac{2800}{(1 + .10)^4} = \frac{2800}{1.10 \times 1.10 \times 1.10 \times 1.10} = \frac{2800}{1.463} = \$1912.40$$

Calculations for Situation A

First Year Cost:

$2800 x 10% x 1 year = $280 interest

Total investment next year.	$2800	(cost)
	280	(interest)
	$3080	

Second Year Cost:

$3080 x 10% x 1 year = $308 interest

Total investment second year.	$3080	
	308	(interest)
	$3388	

Third Year Cost:

$3388 x 10% x 1 year = $338.80 interest

Total investment third year	$3388.00	
	338.80	(interest)
	$3726.80	

Fourth Year Cost:

$3726.80 x 10% x 1 year = $372.68 interest

Total investment fourth year.	$3726.80	
	372.68	(interest)
Total Future Cost	$4099.48	

/Note to Teacher:/ Point out that $1912.40 is the amount, if invested today at 10%, would give $2800 in four years. Thus, $2800 discounted at a 10% rate for four years gives $1912.40. Have students work through a problem similar to this to help establish understanding of discounting concept. For example, determine the total value of a $40,000 farm at the end of 10 years if the interest rate is 6% annually.

Key Questions to Assist Students in Reaching Conclusions:

1. Did the tractor cost more in Situation A or B?
2. Why did it cost more in Situation A? (The added cost of not being able to take advantage of other investments.)
3. In Situation A, what does the difference between $4099.48 and $2800 represent? (Interest cost for 4 years at 10%.)
4. In Situation B, what does discounting mean? (The amount of money which, if invested, would grow to the amount in question for the future.)
5. When a value is discounted, what is involved? (interest)

Conclusions to be Drawn From Example #2:

1. To arrive at the cost of an item in the future, interest cost must be added to the present cost of that item.
2. After an investment is made, the total interest cost increases as the length of time increases.
3. The present cost of an item to become a cost in the future is found by discounting the interest returned.

Example #3. (Present Value of a Baler)

How much could be set aside now at 6% interest to have $1000 to buy a baler 5 years from now?

TABLE 1 [1]

PRESENT VALUE OF $1 OF COST OR INCOME FOR YEARS AND DISCOUNT RATE INDICATED

	Interest Or Discount Rate							
Years	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
1	.962	.957	.952	.943	.935	.926	.917	.909
2	.925	.916	.907	.890	.873	.857	.842	.826
3	.889	.876	.864	.840	.816	.794	.772	.751
4	.855	.839	.823	.792	.763	.735	.708	.683
5	.822	.802	.784	.747	.713	.681	.650	.621
6	.790	.768	.746	.705	.666	.630	.596	.564
7	.760	.735	.711	.665	.623	.583	.547	.513
8	.731	.703	.677	.627	.582	.540	.502	.467
9	.703	.673	.645	.592	.544	.500	.460	.424
10	.676	.644	.614	.558	.508	.463	.422	.386

[1]Earl O. Heady, and Harold R. Jensen, Farm Management Economics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1954), p. 628.

/Note to Teacher:/ The idea to be brought out by this example is the use of a discounting table instead of complicated calculations. Aid students in discovering that from Table 1 the discounted value of $1 at 6% for 5 years is $.747 (about 75¢). Since the baler will cost $1000, they will need to make the following calculations:

$.747 (discount rate/$1) x $1000 (cost of baler) = $747

$747 is the present value discounted.

$747 is the amount we would invest today at 6% to give $1000 in five years.

Refer back to Situation B in Example #2 and point out that the discounted value of $1 at 10% for 4 years is $.683. Thus, $.683 x $2800 = $1912.40.

Table 1 will be used for all discounting in the future. The students might be given problems similar to these to develop understanding. The following examples presuppose the students' understanding of the discounting chart.

Example #4. (Comparison Costs of Tractors)

A farmer needs to buy a tractor. He has a choice between either a new $3000 tractor which will last 10 years or a used tractor with a life of 6 years. He, also, can invest any extra money in his farm business for a 6% return.

Facts:

a. $3000 is the present tractor investment lasting 10 years.

b. $2000 is the present tractor investment lasting 6 years.

c. $1333.20 is needed at end of 6 years to make the comparison on a 10 year life basis. (Based on yearly investment cost $2000 divided by 6)

/Note to Teacher:/ Show that 1/6 of $2000 x 4 years = $1333.20.

Use Table 1 to discount this amount back to the present.

Calculations

$1333.20 discounted for 6 years @ 6% = $939.90

$.705 per $1 (from Table #1) x $1333.20 = $939.90

$939.90 is the amount, if invested at 6%, that would grow to $1333.20 in 6 years.

Comparison

Used Tractor:		New Tractor:	
Cash cost now of used tractor	= $2000.00	Cash cost now of having a tractor for 10 yrs.	= $3000.00
Cash to invest now for second used tractor	= $ 939.90	New tractor's cost now	= $3000.00
		Used tractor's cost now	= $2939.90
Cash cost now of having a tractor for 10 years	= $2939.90	Slight advantage for used tractors	= $ 60.10

/Note to Teacher:/ The replacement value of the used tractor for the last 4 years should be given. Assume that another one could be bought for $2000 that would last for 6 years. Four years of the 10 year life would be equal to $1333.20. This amount plus the $2000 on the first tractor would equal 10 years of life.

Key Questions to Assist Students in Reaching Conclusions:

1. How much longer would the new tractor last than the used one? (4 years)

2. How much money was invested to pay for these last 4 years? ($939.90 -- This amount would have to be set aside at the time the tractor was purchased for $2000.)

3. Why was $939.90 added to the $2000 cost of the used tractor? (To bring the years of life of the used tractors, 10 years, up to the new one.)

Conclusions to be Drawn From Example #4:

1. The lengths of time two investments are being compared must be adjusted to a uniform time.

2. Comparisons can be made between investment choices having dissimilar lengths of life.

Example #5. (Buying a Baler)

Two farmers have a similar decision to make. They must choose either to buy a $2000 hay baler now or invest the money elsewhere and buy the baler 5 years from now.

Leading Questions:

1. Could you buy a good baler for $2000?

2. What else could you buy for $2000?

3. How would you choose between a baler and some other investment? (Choose the one that would make the most money.)

Situation A. Farmer A is young and is working with very limited capital. If he spends $2000 for the baler he cannot use it for lime and fertilizer (an alternate use). Lime and fertilizer would give a 10% return for the investment.

Situation B. Farmer B is an older farmer with more than enough capital to operate his farm business. He has money loaned to his friends at 5% interest. If he does not buy a baler now he can invest the $2000 at 5% for the 5 year period.

Calculations

Farmer A: $2000 discounted for 5 years @ 10% = $1242.

($.621 per $1 from Table 1 x $2000 = $1242)

Farmer B: $2000 discounted for 5 years @ 5% = $1568.

($.784 per $1 from Table 1 x $2000 = $1568)

Comparison from Calculations

Farmer B: Cost of baler now if purchased after 5 years = $1568

Farmer A: Cost of baler now if purchased after 5 years = $1242

Advantage Farmer A would have over Farmer B = $ 326

Estimated Comparison Based on 7% Return to Baler

Farmer A: Buying fertilizer gives 10% return.
Buying baler gives 7% return.
Advantage of fertilizer over baler = 3%

Farmer B: Buying baler gives 7% return.
Loaning to a friend gives 5% return.
Advantage of baler over loaning = 2%

/Note to Teacher:/ The idea to be brought out by this example is that the opportunity to invest will determine the discounting rate.

Key Questions to Assist Students in Reaching Conclusions:

1. Did both farmers have a need for the baler? (Yes; it returned 7% to the investment.)

2. Did both farmers have enough money to buy the baler? (Yes)

3. Could both farmers afford to buy the baler? Why? (No. Farmer A had a better alternative for his limited capital.)

4. Would the decision have been the same if Farmer A could get only 6% return instead of 10%? (No; the return would have been 1% less than the baler then.)

5. What might have been the decision if Farmer A had had unlimited capital? (It would depend on the rate of return he could get elsewhere.)

6. Was the amount of money to invest and length of time the same for both farmers in this comparison? (Yes)

7. Were the choices of these two farmers different? Why? (Yes; there was a difference in opportunity to invest their capital.)

Conclusions to be Drawn From Example #5:

1. When capital is limited, the opportunity costs determine the discounting rate.

2. If time and amounts of capital to invest are the same in two situations, the management decision will be determined by how limited the capital is.

3. As capital becomes more limited, the opportunities to invest capital increase.

4. More opportunities to invest permit a choice of the highest return.

V. ASSOCIATION OF EXAMPLES:

The previous examples show various aspects of how the time comparison principle can be applied. Now, we can associate the conclusions arrived at with each example. The following suggestions may be of assistance in making these associations.

Teacher Activity

1. Bring together the conclusions arrived at following each example. List or duplicate these so the student can refer to them. Discuss them again.

2. Show what these examples have in common by asking the following questions:

   a. What effect does time have on deciding what tractor to buy?

b. How does interest rate effect whether we should buy now or wait until later?

c. Can you calculate the number of dollars you would have to have now to buy a tractor 10 years from now? Is this discounting?

d. What facts would you need in order to find the present value of an item?

e. Would you need to know all investment possibilities available? What would this give?

f. Should the same rate for discounting have been used in each of the examples? Why?

VI. ARRIVING AT THE PRINCIPLE:

Up to now the students have been exposed to examples showing application. If these examples have been effective, the student should be ready to form his understanding into a statement of the principle. This should come from the student and not totally from the teacher.

Teacher Activity

1. Ask a student to tell what this unit is about. Ask for additional contributions from others.

2. Develop a list of terms and meanings as the student understands them.

3. Clear up any apparent misconceptions.

4. Ask a student to apply what has been studied to a realistic farm situation.

5. Have all students write on paper, in their own words, a statement of the principle.

6. Develop some definitions on the board from their papers, and select a definition something like: "Before investing limited capital resources in the farm business, the farm manager should determine the present value of future income

in order to make comparisons between alternatives over time; that is, determine the economic feasibility of making capital investments in the present to obtain income in the future.

VII. STUDENT ACTIVITIES:

By applying this principle in solving realistic problems, the student will develop a more complete understanding of the principle.

Activity #1. The following are possible problems the teacher may want the students to solve. These may also be used for evaluating or testing the student.

Problem 1. How much should a farmer give for an orchard that will return a total net in 30 years of $15,000 if he has an alternative of raising field crops at 7% net return?

Problem 2. Which barn to build? (a) $5000 to last 60 years, (b) $4000 to last 30 years, based on 4% and 10% interest rates. (Show figures.)

Problem 3. Should a permanent fence lasting 40 years and costing $2000 be built or a temporary fence lasting 20 years costing $1000? (Show figures.)

Problem 4. To have $200 now @ $1 = $_____ needed now.

To have $200 in 10 years @ .614 = $_____ needed now.

To have $200 in 20 years @ .377 = $_____ needed now.

To have $200 in 30 years @ .231 = $_____ needed now.

STUDENT WORK SHEET

MONEY AND THE FUTURE

Money makes money when invested in:

A business

Livestock to feed out

The stock market

A bank savings account.

If you spend money for something that gives no return on your investment (such as a car) you create a personal cost.

Compare $2000 spent on a car with $2000 invested in the bank for 5 years.

Cost of Car		$2000 with interest at 4% compounded annually for 5 years
$2000	1st year	$2000 × .04 =
	2nd year	$_____ × .04 =
	3rd year	$_____ × .04 =
	4th year	$_____ × .04 =
	5th year	$_____ × .04 =
	Total amount of interest earned on the $2000 during the five years =	$_____

The cost of the car was actually the $2000 plus the amount of interest that you would have received if you had invested the $2000 in the bank (less salvage value of car).

STUDENT WORK SHEET

INVESTING IN THE FUTURE

Sometimes it is desirable to lay aside a certain amount of money for a future purpose or expenditure. If you needed $1000 five years from now, it would not be necessary to invest that amount in the bank today.

The following table lists the percentages needed to be set aside today to accumulate one dollar over a period of years at given interest rates.

TABLE 1 [1]

PRESENT VALUE OF $1 OF COST OR INCOME FOR YEARS AND DISCOUNT RATE INDICATED

Years	Interest or Discount Rate							
	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
1	.962	.957	.952	.943	.935	.926	.917	.909
2	.925	.916	.907	.890	.873	.857	.842	.826
3	.889	.876	.864	.840	.816	.794	.772	.751
4	.855	.839	.823	.792	.763	.735	.708	.683
5	.822	.802	.784	.747	.713	.681	.650	.621
6	.790	.768	.746	.705	.666	.630	.596	.564
7	.760	.735	.711	.665	.623	.583	.547	.513
8	.731	.703	.677	.627	.582	.540	.502	.467
9	.703	.673	.645	.592	.544	.500	.460	.424
10	.676	.644	.614	.558	.508	.463	.422	.386

[1]Earl O. Heady, and Harold R. Jensen, Farm Management Economics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1954), p. 628.

For a fund of $1000 to be accumulated, how much would you need to set aside:

for 5 years at 4% _____ for 7 years at 6% _____

for 3 years at 5% _____ for 4 years at 7% _____

for 10 years at 5% _____ for 10 years at 10% _____

STUDENT WORK SHEET

INVESTMENT IN A FARM VS. A BANK

The Farm: (Compute)

150 acres of land including buildings at $400 per acre . . $_____

Livestock:

50 cows at $350 each . . . . . $_____
20 sows at $75 each . . . . . _____
40 sheep at $20 each . . . . . _____

Total value of livestock . . . . . $_____

Equipment:

1 tractor at $5000 . . . . . $_____
1 tractor at $3000 . . . . . _____
1 combine at $3000 . . . . . _____
1 corn picker at $1800 . . . . . _____
2 plows at $300 each . . . . . _____
1 disc at $1200 . . . . . _____
1 corn planter at $500 . . . . . _____
1 grain drill at $700 . . . . . _____
2 wagons at $300 each . . . . . _____
1 baler at $2400 . . . . . _____

Total value of equipment . . . . . $_____

If this farm showed a net profit of $6000, what would be the % return on the investment in the farm? . . . . . _____%

The Bank: (Compute)

At 4% interest from the bank, what would be the net return on $6000 ? . . . . . $_____

Solution:

The best investment is in _____.

SAMPLE QUIZ ON TIME RELATIONSHIPS

1. Which of the following farmers would be most likely to invest in a long-range soil conservation plan?
   _____a. A beginning farmer who is short on capital.
   _____b. A tenant with a long-term lease.
   _____c. An owner-operator with money in a savings account.
   _____d. An owner-operator who is heavily in debt.

2. Explain your answer to question number 1.

3. A dairyman was milking 50 Holstein cows with a yearly milk production record of 8000# per cow. He had $10,000 to invest in his dairy enterprise and was faced with the following alternatives: (1) Invest $10,000 in an ultra-modern feeding system, or (2) Invest $6,000 in a "conventional type" feeding system and have $4000 to invest in higher producing cows. He decided to invest the $10,000 in the modern feeding system. He made the wrong decision. Why?
   _____a. The annual depreciation charge is more than he can profitably afford.
   _____b. $10,000 is too much to invest in buildings and equipment for 50 cows.
   _____c. The added returns from the investment in high producing cows would have yielded more profit to the farmer in the long run than the new feeding system.
   _____d. His neighbors think he made a mistake.

4. State your concept of the economic principle of time relationships.

SAMPLE QUIZ ON TIME RELATIONSHIPS

True or False

1. __T__ We can figure a present value of a future cost.

2. __F__ $400 at 6% will return more than 00 at 3%.

3. __T__ Interest rate is the % of interest charged for the use of capital.

4. __T__ To compare in time means to reduce all future values to the present value.

Completion

5. Future cost may be __discounted__ to give it a present cost.

6. The income from an investment is called the rate of return or % of __interest__.

7. The cost or returns from an investment are affected by __interest rate__ and __time__.

8. If $2000 is discounted for 10 years at 6% ($.558 on the dollar), its present value is __$1116.__.

9. All future values can be reduced to a present value by using a __time__ comparison.

Problem

10. A farmer needs a feed rack. Should he build a wooden one costing $100 that will last for 10 years or a metal one costing $200 that will last for 20 years if his investment opportunity will give an 8% return?

    Answer: Wooden feed rack.

    Solution: .463* x $100 = $46.30
    metal - $200 - 20 years
    wood - $100 + $46.30 - 20 years

metal	$200.00	- 20 years
wood	-146.30	- 20 years
	$ 53.70	Advantage of wooden feed rack.

    *From Table 1

VIII. SOURCES - REFERENCES

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